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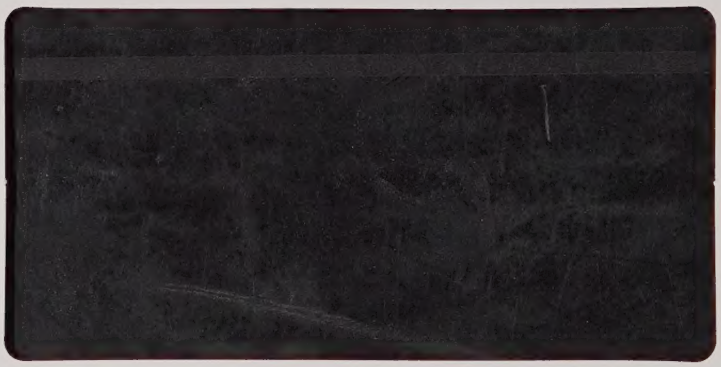

USERS GUIDE &

TECHNICAL REFERENCE

BEHLMAN MODEL KBT-10-C

BEHLMAN
An Astrosystems Company
6 Nevada Drive
Lake Success, NY 11042

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SCHEMATICS AND PARTS LIST

BEHLMAN MODEL KBT-10-C

DESCRIPTION	ASSY NO.	SCHEMATIC DWG. NO.	COMP LAYOUT NO.
CHASSIS LAYOUT			12-120
FUNCTIONAL BLOCK DIAGRAM			B-2358
KB FRONT PANEL	16-293	B-2658	B-2659
MOTHER BOARD	16-149	C-1004	B-1889
MICROPROCESSOR CARD	16-141	B-5306	B-5307
DIGITAL FREQUENCY CARD	16-463	B-5352	B-5368
MEASUREMENT CARD	16-189	B-1868	B-2050
VOLTAGE CARD	16-179	B-1859	B-2037
DRIVER	16-001	B-1274	B-2030
DC POWER SUPPLY (UNRGLTD)	16-193	B-2062	B-2063

WARRANTY

Behlman products are warranted against defects in materials and workmanship, and Behlman agrees to repair or replace any product that fails to perform as specified within two years of date of shipment when returned to Behlman with transportation prepaid by the buyer. This warranty shall not apply to any product that has been:

1) Connected, installed, adjusted or used otherwise than in accordance with the instructions furnished by Behlman.

2) Subject to misuse, negligence, or accident.

3) Repaired, worked on, or altered by person(s) unauthorized by Behlman in such manner as to injure, in Behlman's sole judgement, the performance, stability, or reliability of the product.

No other than warranty is expressed or implied. Behlman is not liable for consequential damages, for failures of delivery in whole or part, or injuries resulting from its use, or for any other cause.

Behlman's sole liabilities, and buyer's sole remedies, under this agreement, shall be limited to a refund of the purchase price, or at Behlman's sole discretion, to the repair or replacement of the product that proves, upon Behlman's examination, to be defective.

CLAIM FOR DAMAGE IN SHIPMENT

Under the FOB factory terms of sale, ownership and responsibility are transfered to the customer when the equipment leaves the factory. Each Behlman instrument is shipped from the factory in proper operating condition.

Immediately upon receiving the instrument, unpack and inspect it for evidence of damage incurred in shipment. Unless the equipment has been extensively damaged and is obviously inoperable, check its operation. File a claim with the freight carrier if the equipment has been damaged in any way or if it fails to operate properly. Forward a copy of the damage claim report to Behlman. Include the model number, serial number and date the shipment was received. Behlman will advise the disposition of the equipment and will arrange for the necessary repair or replacement.

RETURNING EQUIPMENT TO FACTORY

This equipment, like all precision electronic equipment, is susceptible to shipping damage. It contains heavy magnetic components as well as delicate electronic components. For this reason, it is advantageous to effect repairs through the local service representative whenever possible.

Do not return equipment to the factory without prior authorization from Behlman.

If equipment is returned to the factory without prior authorization the customer is liable for all shipping, handling and repair costs.

When packaging for re-shipment, use the original shock-absorbent material and the shipping container, to preclude damage to the equipment.

Behlman
1142 Mark Avenue
Carpinteria, California 93013
Telephone number: (805) 684-8311

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SECTION 1 INTRODUCTION AND SPECIFICATIONS

1.1 GENERAL DESCRIPTION

The Behlman model KBT-10-C is a highly sophisticated Programmable A.C. Power Supply with an integrated measurement capability that provides independent verification of operating values, thus reducing the need for external measurement instrumentation. Control of the power supply output voltage and frequency is accomplished through a front panel keyboard entry system or via the Optional Interface Bus. Reporting of the output voltage, frequency, and load current measurements are furnished by a front panel alpha-numeric display or via the Optional Interface Bus.

A unique feature of the power supply is the microprocessor controlled synthesized sinewave oscillator. This oscillator generates very accurate and stable output voltages and frequencies and through the use of the keyboard or Optional Interface Bus, provides the user with excellent control resolution.

The conservative design approach of the power amplifier section allows for full volt-ampere and current ratings into loads having power factors down to zero, either leading or lagging. In addition, an extremely high degree of feedback is used to help achieve low output distortion and tight line and load regulation. The output power is transformer coupled to provide excellent load isolation.

The autorange feature automatically places the output transformer windings in series or parallel, thereby providing the highest current capability for any output voltage selected. The fixed voltage ranges provide stepping of the output voltage over the entire voltage range, without range-switching disturbances.

Another unique feature of this is the continual operating test performed by the onboard microprocessor. These tests will detect conditions such as low input line, cabinet over-heating, over-voltage, over-current, or incorrect calibration, and notify the user via front panel (and optional RS-232 or IEEE-488 SRQ line) of failure.

A front panel keyswitch provides locking REMOTE and LOCAL operating modes, as well as the LOCK position which inhibits new operating values from being entered.

SPECIFICATIONS	MODEL KBT-10-C
INPUT POWER:	115 Vac ±10%, 3 amperes maximum or, 230 Vac ±10%, 1.5 amperes maximum, 48-72 Hz, single phase.
RATED OUTPUT POWER:	100 volt-amperes, single phase.
MAXIMUM OUTPUT POWER:	150 volt-amperes, single phase. (Unity P.F. load, 135 or 270 Vac output, 55-1600 Hz, nominal input line).
OUTPUT VOLTAGE RANGES:	Fixed ranges of 0-135 and 0-270 Vac, and 0-270 autorange with automatic change at 135 Vac.
FULL POWER RANGES:	100-135 Vac and 200-270 Vac.
RATED CURRENT:	1 ampere in 0-135 Vac range. .5 ampere in 0-270 and 135-270 Vac ranges.
MAXIMUM CURRENT:	1.2 amperes in 0-135 Vac range. .6 ampere in 0-270 Vac range. (Unity power factor load.)
FREQUENCY RANGE:	45-2000 Hz.
FREQUENCY RESOLUTION:	0.1 Hz steps.
FREQUENCY ACCURACY:	±0.05%.
VOLTAGE RESOLUTION:	0.1 volt steps, 0-270 volts.
VOLTAGE ACCURACY:	±0.2% of full scale.
AMMETER ACCURACY:	±0.5% of full scale.
DISTORTION:	1% maximum THD.
LOAD POWER FACTOR:	Down to zero leading or lagging, at 25°C ambient.
LOAD REGULATION:	±0.5% no load to full load.
OVERLOAD AND SHORT CIRCUIT PROTECTION:	Instantaneous electronic protector plus line circuit breaker. Electronic protector returns output to normal as soon as overload or short circuit is removed.
SIZE:	5.25"Hx19"Wx19"D.
WEIGHT:	35 lbs.

1.2.1 SOFTWARE LOG

PROM #1.	PROM #2	PROM #3

SECTION 2 UNPACKING AND INSTALLATION

2.1 UNPACKING

After unpacking power supply carefully conduct a thorough inspection of controls, indicators and chassis. If power supply shows signs of damage do not attempt to operate. File a damage claim with the carrier responsible. Notify Behlman immediately.

2.2 INSTALLATION

1) This equipment is intended as a rack mounting unit. When installing in a rack or cabinet support under the chassis must be provided. Do not attempt to mount by front panel only. For proper cooling air circulation the following clearances must be provided:

3/4 inch above chassis (or cabinet)
8 inches at front and rear of chassis (or cabinet)

2) Be sure LINE circuit breaker and all other controls are in OFF position before connecting input power.

3) Place INPUT SELECT switch, located at the rear of the instrument, in 115 or 230 Vac position as required. Connect line cord to power connector on the rear of the instrument and then to power-line receptacle. (Input-line fuse is same for either input voltage).

SECTION 3 OPERATION

3.1 OPERATION-LOCAL

3.1.1 INTRODUCTION

A keyboard entry system is used for manual control of output frequency and output voltage. Frequency, voltage, adjustable phase angle (Option 380) and current limit/monitor (Options 384, 385) requirements are entered utilizing the 0-9 and decimal point keys. To enter frequency, voltage, phase angle or current limit/monitor, depress the "V" (voltage), "F" (frequency), "P" (phase angle) or "I" (optional current monitor or current limit) keys, then enter the desired values. Although the "F", "V", "P" or "I" key will immediately clear the display, the previously selected operating value will not change until the "E" (enter) key is depressed after each selection.

"∧" and "∨" keys are used to increment or decrement the output frequency, voltage, current monitor or current limit in steps of 0.1 or larger, and phase angle in steps of 1.0 degrees or larger.

Models with remote programming (Options 450 through 453) feature a front panel keyswitch which provides locking REMOTE and LOCAL operating modes, as well as the LOCK position which inhibits new operating values from being entered.

The power supply has one of four output range configurations:

1) Standard single voltage range.

2) Two fixed voltage ranges including AUTORANGE (Option 202).

3) Three voltage ranges including AUTORANGE (Option 205).

4) Two low voltage ranges including AUTORANGE (Option 204).

A front panel OUTPUT RANGE switch is provided with mulitiple output range models.

The error messages for incorrect data entry are "NO PREVIOUS INCREMENT INPUT", "INPUT FORMAT ERROR" or "INPUT TOO LONG, RE-ENTER PLEASE". The error message will be displayed for five seconds before reverting to the previous operating condition.

The Self Monitoring feature (Option 350) provides continual operating tests performed by the on-board microprocessor. These tests will detect conditions such as low input line, cabinet over-heating, over-voltage, over-current, and incorrect calibration, and notify the user via the front panel (and optional RS-232 or IEEE-488 SRQ line) of the failure.

The alpha-numeric readout is used to display output frequency, voltage and load current. The values presented by the readout are the actual measured, not entered, values.

WARNING

This equipment involves the use of voltages and currents that can be hazardous. Only qualified personnel should be allowed to operate or service it. The top cover/s must always be in place during operation.

3.1.2 TURN ON PROCEDURE

1) Be sure all three LINE circuit breakers and OUTPUT switch are in OFF position.

2) With non remote sense units, connect a suitable load across output terminals (do not exceed rating of unit). Load may be left floating or any phase or neutral may be connected to ground.

Note: Front control panel binding posts are rated at 30 amperes maximum. Test jacks are used for output voltage monitoring ONLY.

3) With Options 361 and 375, load and remote sense lines may be connected in the various configurations as instructed below.

a) **When Remote sense is desired:**

Caution must be exercised, because the remote sense lines are connected to the loads and carry the same potentials as the power outputs. Depending on the application, three, four, or six sense lines may be used. The load may be left floating, or any phase or neutral may be connected to ground.

Use shielded, twisted pairs for sense lines to minimize noise pick-up in noisy environments. A chassis grounding point is provided near the remote sense terminals for the shields. To avoid ground loops, attention must be paid to proper shield grounding practices.

Listed below are four different examples for connecting the remote sense.

Example 1. Connect the load in Delta configuration. Connect the AØ sense line to the AØ load terminal, the BØ sense line to the BØ load terminal, and the CØ sense line to the CØ load terminal. Jumper the three sense neutrals and connect them to the power output terminal block neutral. Noise pick-up may be a problem with a Delta hookup.

Example 2. Connect the load in a Wye configuration. Connect the AØ sense line to the AØ load, the BØ sense line to the BØ load and the CØ sense line to the CØ load. Jumper the three sense neutrals and connect them to the common load neutral.

Example 3. Connect the load in a Wye configuration. The load neutral may be connected to the power output neutral or may be left floating. Connect each shielded, twisted pair of sense lines directly across the corresponding load. Carefully check for proper phase and neutral sense line hookup.

Example 4. Connect the load in a Wye configuration. Connect each load neutral directly to the power output terminal block neutral. Connect each shielded, twisted pair of sense lines directly across the corresponding load. Carefully check for proper phase and neutral sense line hookup.

b) **When Remote Sense is not desired:**

The Remote Sense terminals should not be allowed to float. Doing so may result in poor performance. Shorting a remote sense input can cause the output voltage to jump to unexpectedly high voltages so caution must be exercised. The remote sense termminals and any wires connected to them carry voltages as high as the output connections. These voltages are potentially lethal and must be treated accordingly.

i) Connect the remote sense leads to the output terminals. Be careful of polarity and phase relations. Failure to do so may resulst in poor regulation and unstable transients response.

ii) Connect the load across the output terminals (do not exceed the rating of the unit). The load may be left floating, or any phase or neutral may be grounded.

4) Units with Options 450, 451, 452 or 453 require that the keyswitch be placed in the LOCAL position.

5) Place OUTPUT RANGE switch in desired output voltage range.
Note: When the range switch is changed, the output voltage goes to zero.

6) Place LINE circuit breaker in ON position (red power indicator should illuminate and cooling-fan noise should become evident). The output will initialize at 0.0 Volts, 400 Hz. The display will show the voltages of all phases and the output frequency.

3.1.3 PROGRAMMING FREQUENCY

1) Depress "F" key to clear display for frequency change.

2) Enter desired frequency data.

3) Depress "E" key to enter new frequency data.

3.1.4 PROGRAMMING VOLTAGE

1) Depress "V" key to clear display for voltage change.

2) Enter desired voltage data. (0.1 volt resolution).

3) Depress "E" key to enter new voltage data.

3.1.5 PROGRAMMING VOLTAGE INDEPENDENTLY (OPTIONAL)

1) Depress "V" key.

2) Depress "A", "B", or "C" key to specify desired phase.

2) Enter desired voltage data. (0.1 volt resolution).

3) Depress "E" key to enter new voltage data.

3.1.6 PROGRAMMING PHASE INDEPENDENTLY (OPTIONAL)

1) Push "P" key.

2) Push "B" or "C" key to specify desired phase.

3) Enter new phase angle data. (1.0 degree resolution). Data are degrees lagging as referenced to "A" phase.

4) Push "E" key to enter new data.

3.1.7 PROGRAMMING ADJUSTABLE CURRENT THRESHOLD MONITOR OR CURRENT LIMIT (OPTIONAL)

Option 384 provides an Adjustable Current Limit feature, while Option 385 provides Adjustable current Threshold Monitor. To program current monitor or current limit values:

1) Depress "I" key to clear display for change.

2) Enter desired current monitor or current limit value. Starting at 0.5A, increment in 0.1 steps or larger up to maximum current, with 0.1A resolution.)

3) Depress "E" key to enter new value.

3.1.7.1 PROGRAMMING THE OUTPUT POWER RELAY AT CURRENT THRESHOLD

Using local or remote programming, it is possible (with Option 385 only) to control the output relay at current threshold. This control allows the user to determine whether the KB output power is maintained once current threshold is achieved. The commands to control the output relay are:

1) "I.^" will cause the output relay to de-energize whenever a current threshold is reached. This is the default state.

2) "I.v" will cause the output relay to remain energized whenever a current threshold is reached.

3.1.8 INCREMENTAL STEPPING

Incremental stepping of the output frequency or voltage is accomplished as follows:

1) Depress key representing function to be incremented, "F", "V", "P" (optional phase angle control) or "I" (optional current monitor or current limit.) For independent stepping of phase angle or voltage, depress A, B or C after depressing "P".

2) Enter desired step change of 0.1 or larger for frequency, voltage or current limit/monitor, and 1.0 for independent phase angle control. Step can be any value from the resolution to maximum value of the function being incremented.

3) Depress "^" (increment) or "v" (decrement) key as desired.

4) Depress "^" or "v" again to repeat previous step change in the specific direction. This may be repeated as many times as desired.

5) The step value may be changed without changing the function by simply entering new step size and depressing "∧" or "v" as before.
Note: The power supply will step only to the limits of its frequency, voltage and current specifications.

3.1.9 LOCAL/LOCK/REMOTE KEYSWITCH (OPTIONAL)

The LOCAL/LOCK/REMOTE keyswitch is provided for units purchased with all 400-series options to select local or remote programming.

1) The LOCAL position enables the entry of data from the front panel keyboard while disabling any programming from the remote interface. This mode cannot be entered from REMOTE if a programming change is being made, or if the unit has been placed in Local Lockout by the remote interface.

2) The REMOTE position enables the remote interface to send commands to the unit. When in this mode, local programming, via keyboard and other controls, is possible until the remote interface disables it by programming the Remote Enable (REN) command. After the REN has been sent, programming is accomplished via the remote interface until the Go to Local command is sent over the remote interface. This command again enables the unit to be programmed via the front panel.

3) The LOCK position inhibits programming of the unit from keyboard or remote interface without affecting current programmed values. This mode cannot be entered if a programming change is being input. Although the switch can be actuated, the change will be ignored until the programming change is completed.

3.1.10 OUTPUT RANGE CONTROL

The OUTPUT RANGE control allows user selection of standard and optional output voltage ranges. The fixed voltage ranges restrict the output voltage to their maximum individual output range. The AUTORANGE feature allows the power supply to switch voltage ranges at specified output voltage levels depending on model output voltage specifications. Changing the OUTPUT RANGE control causes the output voltage to be reduced to zero. Full power available over each voltage range is specified in the model's specification sheet (Section 1.2).

3.1.11 FORMATTING THE DISPLAY

The front panel flourescent display can be formatted to display any combination of available readings anywhere in the four available display fields. The new reading is placed in the field farthest to the right, displacing the old readings one field to the left. These commands are:

There is a group of commands entered via the keyboard that control the displayed data. These are divided into groups. The first group will reprogram the entire display. These are "VE", "IE", "PE", "TE" and "fE". Each of these brings up the voltage, current, phase angle, real power, or power factor respectively, of all phases plus the frequency.

1) Increase input line capability. Increase Line "stiffness."

2) Decrease output load requirements.

3) Decrease output voltage.

CABINET TEMPERATURE

The power supply monitors three areas of the chassis where over-heating would have the most detrimental effect on the unit. If the temperature of any one of these areas rises beyond a pre-determined limit, the message CABINET TEMPERATURE TOO HIGH will be displayed and the output will be shut down in an effort to minimize possible damage. The actual sense points are in the heat sinks for the output transistors, and the temperature cutoff point is approximately 130° C. There are several possible causes and remedies listed here:

Cooling fan failure	Replace fans.
Air intake filter clogged	Clean or replace filter.
Improper chassis clearance	Increase air space around chassis to improve air flow.
Environment temperature too high	Cool room, improve air flow.
Load too heavy	A high load should not cause over-heating except when coupled with one of the other problems mentioned. It is not recommended to run the unit with improper cooling. In such cases where user neglect is determined, running the unit with improper cooling could void the warranty.

SETTING/READING CALIBRATION

The microprocessor checks continously the reading values against the programmed values to make sure they are within specifications. Note that the programmed value the processor checks is the value it outputs to the amplifier, and not necessarily the value entered by the operator. (i.e. If the operator entered 280 Vac, the programmed value would be 270 Vac because the power supply cannot output 280 Vac.)

If the check fails, the message SETTING/READING MISMATCH is shown and the unit waits for operator intervention. The output is not disabled in this case. The causes of the error and some possible remedies are:

Sense lines improperly connected	Connect sense lines across load under test
Load too heavy for range or voltage	Decrease load (overload point exceeded). Decrease output voltage. Change range.
Unit out of calibration	Refer to calibration manual or consult factory for instructions.

The second group brings up one reading only. The new reading is placed in the field farthest to the right, displacing the old readings one field to the left. These commands are:

"IAE"	Current A phase	"TAE"	Real Power A phase
"IBE"	Current B phase	"TBE"	Real Power B phase
"ICE"	Current C phase	"TCE"	Real Power C phase
"VAE"	Amplitude A phase	"fAE"	Power Factor A phase
"VBE"	Amplitude B phase	"fBE"	Power Factor B phase
"VCE"	Amplitude C phase	"fCE"	Power Factor C phase
"PAE"	Phase angle A-A		
"PBE"	Phase angle B-A		
"PCE"	Phase angle C-A		
"FE"	Frequency		

3.1.12 SELF TEST

The Self Test feature provides a method to verify the operation of the unit. During this test, the unit automatically sequences through the entire operating range of the unit and checks the measured values against the programmed values. This not only will verify the calibration of the unit, but will point out any possible trouble spots in the oscillator or amplifier. The Self Test Mode can be entered from the Local or Remote modes.

To enter the Self Test mode:

1) AUTORANGE is selected automatically for the most complete test.

2) Place an optional load on the output. The test will program the unit to maximum voltage; make sure rated power of unit is not exceeded. Hook the sense lines across the load and turn OUTPUT switch ON.

3) If test is to be conducted unloaded, turn OUTPUT switch OFF.

4) Enter the combination "V.F.E" on the keyboard.

At this point, the unit will display SELF TEST as well as the programmed and measured values for the amplitude and frequency as it verifies them. To abort the test and reset the unit to the initial turn-on conditions, depress "E" at any time during the test. When the test is completed, the message SELF TEST COMPLETE. PRESS E will be displayed. At this time, depress "E" on the keyboard and the unit will reset to the conditions of initial turn-on. If the test fails, the message TEST FAILED @ as well as programmed and measured values that occured at failure will be shown. Again, depressing the "E" key will reset the unit to initial turn-on conditions.

Problems that can arise are:

Sense lines disconnected	Connect Sense lines. Turn OUTPUT switch OFF.
Load too heavy:	Decrease load. Turn OFF the OUTPUT switch.
Unit miscalibrated:	Refer to Calibration manual or consult factory for assistance.

3.1.13 SELF MONITORING LEVEL II DIAGNOSTICS (OPTIONAL)

Any power supply purchased with Option 350 has built-in diagnostic capabilities. This feature enables the unit to continuallly monitor the status of the circuitry and report any imminent failures to the operator. There are four tests that are continuously made. These tests are:

1) Current (or optional current limit)

2) Cabinet temperature

3) Input line monitor

4) Setting/Reading calibration

All these tests will report the error condition via the front panel and by affecting the optional interface bus SRQ line or optional interface. (See section on REMOTE OPERATION for details of remote interface error reporting.) When an error is detected, normal operation is suspended and the unit waits for operator intervention before resuming normal operation. Some errors cause no effect on the output while others will shut down the output until the error is corrected. The cause of the failure and the subsequent remedy is beyond the scope of the internal computer program and determining the reason and remedy is left to the operator. Below is an explanation of how the error is determined by the computer and some possible causes and fixes. Reprogramming any output value, Frequency, Voltage or Current limit, will reset the display and resume normal operation assuming the error condition has been corrected.

CURRENT MONITOR SHUTDOWN (OPTIONAL)

Units featuring Option 385 provide an adjustable current monitor which is user settable (see Section 3.1.7). If, at any time, the measured output current exceeds the set limit, the output relay will be turned off and the message OUTPUT CURRENT OVER SET LIMIT will be displayed. The current measurement circuitry incorporates a peak rejection feature that effectively filters out such things as inrush current and transient spikes. The current monitor feature is most useful when the user wants to protect the load under test from excessive current and hence it is up to the operator to decide what action should be taken to remedy the over-current condition. The power supply itself has other features that protect it from excessive output current damage.

CURRENT LIMIT (OPTIONAL)

This feature (option 384) is also user settable (See section 3.1.7) and responds similarly to the current monitor shutdown except the output voltage is decreased until the output current reaches the set limit value.

INPUT LINE MONITORING

The input power line is constantly monitored and compared to a value 10% below the nominal input voltage. If at any time the input voltage drops below this value the message INPUT LINE VOLTAGE TOO LOW will be displayed. The unit will continue to operate normally, except for the display, but it should be noted that the output may not meet specifications. The possible remedies are:

3.1.14 EXTERNAL SYNC INPUT (OPTIONAL)

Behlman Option 386 allows syncronization of the power supply output to an external signal source. The input signal required is 2 to 10 Vac and must be within the frequency bandwidth of the power supply. Apply the sync signal to the EXT SYNC connector located on the instrument.

3.1.15 EXTERNAL OUTPUT FOR SYNC (OPTIONAL)

Option 387 and 388 allows syncronization of an external instrument or circuit to the output of the power supply. The output sync signal is a 5.1 volt squarewave with a 50% duty cycle, AØ referenced, or a 9.2 Vac sinewave, respectively, with a frequency range of the specified bandwith of the power supply.

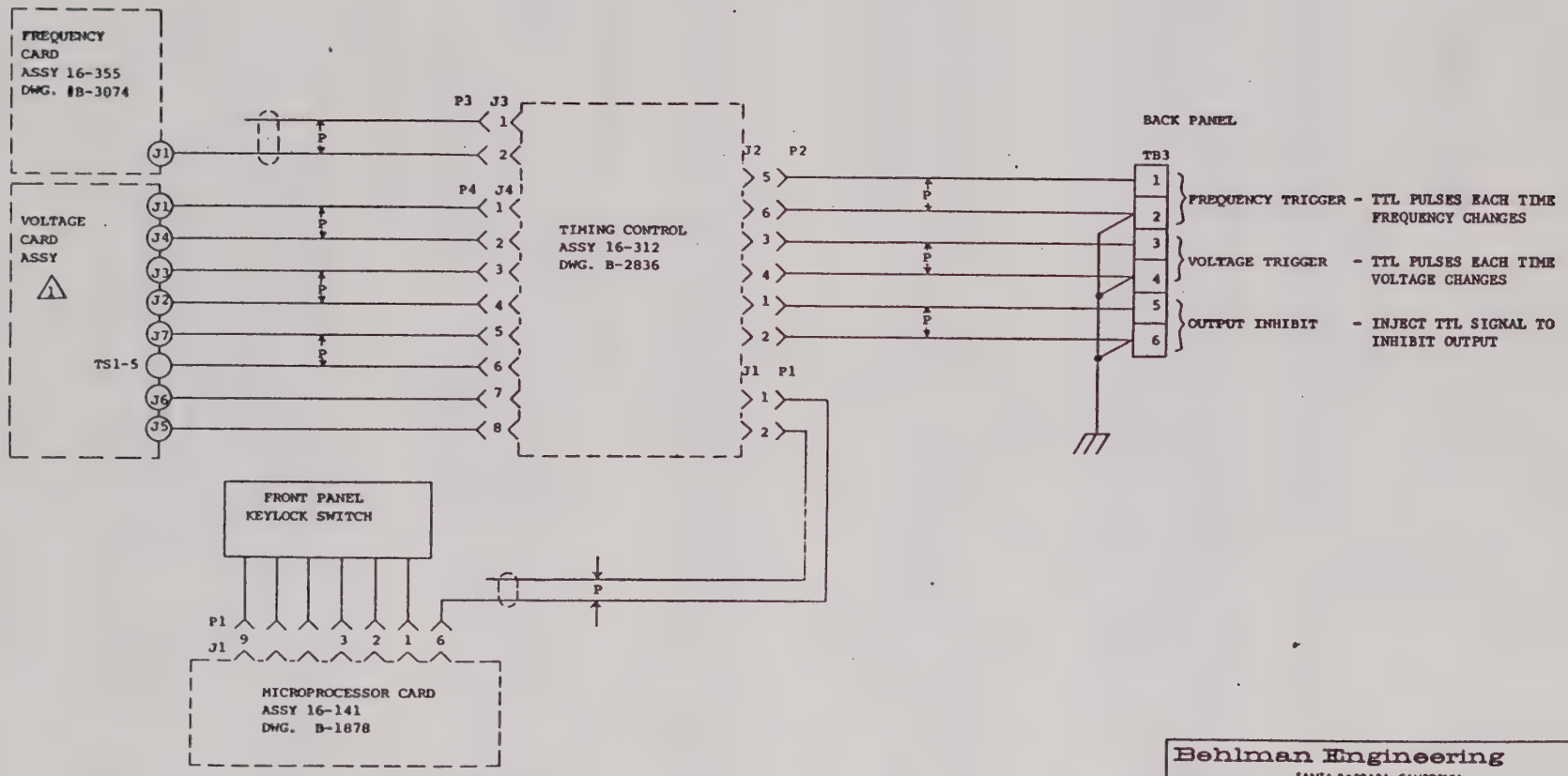
3.1.16 OPTIONS 389 AND 390

These options are included with option 376. Option 389 is Voltage/Frequency Transtition Trigger. Whenever a voltage or frequency change occurs, there will be a TTL pulse generated at TB3-Pins 1 (Frequency) and 3 (Voltage). Ground is found at TB3-2,4,6. Option 390 is Output Inhibit via TTL. By sending a TTL to TB3-5, the operator is able to inhibit the output of the supply. See diagram B-2928 for details.

3.1.17 SHUTDOWN PROCEDURE

1) Place OUTPUT switch in OFF position.

2) Place LINE circuit breaker in OFF position.



1 VOLTAGE CARD ASSEMBLIES 16-378 DWG. NO. B-3169 (1Ø) AND 16-390 DWG. NO. B-3221 (3Ø) ARE REQUIRED WHEN OPTIONS 361 OR 362 ARE USED IN CONJUNCTION WITH OPTION 376. VOLTAGE CARD ASSEMBLIES 16-311 DWG. NO. B-2749 (1Ø) OR 16-389 DWG. NO. B-3219 (3Ø) ARE UTILIZED, UNLESS POWER MEASUREMENT (OPTIONS 361/362) IS PRESENT.

	16-312
USED ON	USED ON
APPLICATION	

Behlman Engineering
SANTA BARBARA, CALIFORNIA

DRAWN BY RAK	APPROVED BY
DATE 7-10-86	REVISED
TITLE TIMING CONTROL INTERCONNECTION DIAGRAM	
ASSY NO.	DRAWING NO. B-2928 REV D

AB DRAWING NO 83748

MAINTENANCE AND CALIBRATION

SAFETY NOTE

This equipment involves the use of voltages and currents that can be hazardous. Only qualified personnel should be allowed to operate or service it.

Before performing any of the following maintenance or adjustment procedures, where access to the inside of the equipment is required, be sure to discharge the D.C. power supply filter capacitor/s. After placing the LINE circuit breaker in the OFF position use a 25 to 100 ohm, 25 watt resistor to first discharge capacitor C2 (when used) and then capacitor C1. (See chassis layout drawings for location of the capacitors.)

MAINTENANCE

1 AIR FILTERS

Air filters, when used, should be cleaned every six months, or more often if required. Metal mesh filters should be removed, cleaned in soapy water, rinsed, dried and sprayed with an appropriate filter spray. Plastic foam filters merely require cleaning with a vacuum cleaner from the outside.

2 ADJUSTMENTS

Before performing the following adjustments, allow the equipment to warm up for approximately one hour, with the top cover/s on and no output load. DO NOT ATTEMPT TO MAKE ANY ADJUSTMENTS OTHER THAN THOSE DESCRIBED BELOW.

2.1 DRIVER POSITIVE FEEDBACK ADJUSTMENT

With the power supply output voltage adjusted to the desired level and the output-switch in the ON position, connect a load of approprate value to the output terminals. Note the variation in output voltage as the load is connected. Adjust the positive-feedback potentiometer (R4) with the load connected so as to obtain the same output voltage as in the unloaded state, within the specifications of the unit.

2.2 DRIVER OVERLOAD AJUSTMENT

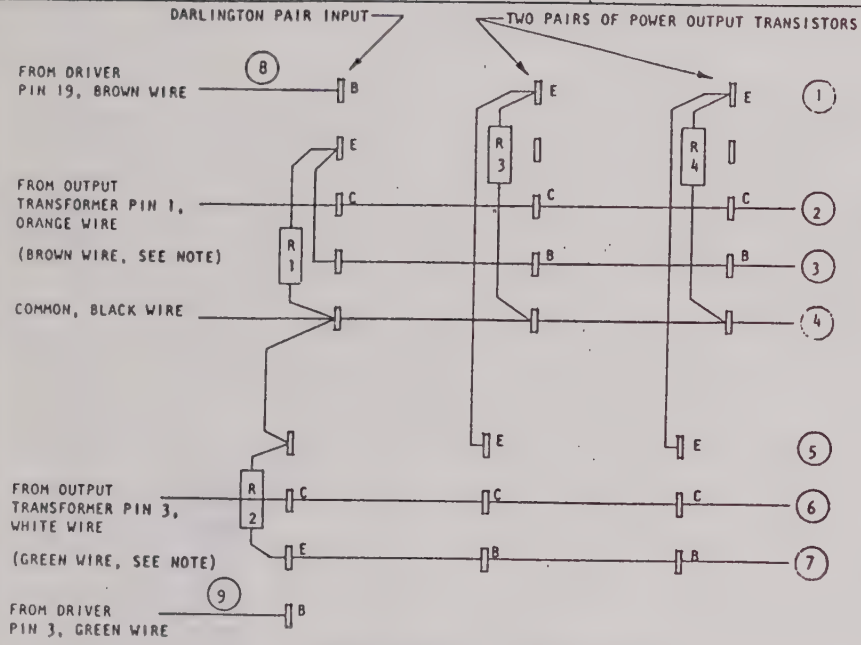
This adjustment should be made with the use of an oscilloscope monitoring the output voltage waveshape. Select a resistive load that will draw 120% of the unit's rated output current at 77-92% of the unit's maximum output voltage (100-120 volts on 0-130 volt unit). With the load applied to the output terminals, and the output switch in the ON position, increase the output voltage to the point at which 120% of the rated current will flow through the load. At this point the peaks of the output sinewave should just begin to clip. If this clipping onset does not occur, adjustment of the overload potentiometer (R13) should be made. The clipping level is designed to vary somewhat with temperature, so as to limit the output to lower levels at higher temperatures.

NOTE

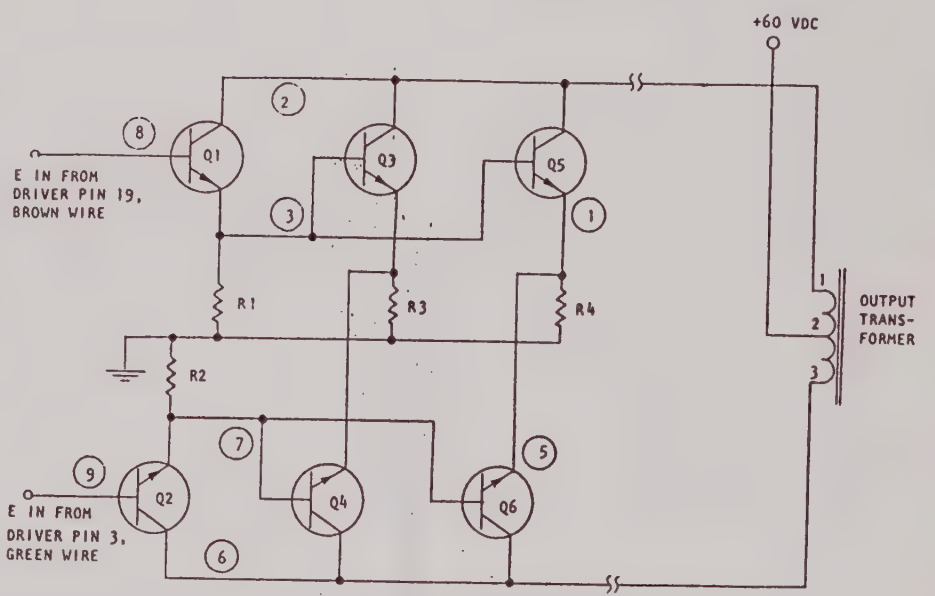
On multi-phase models (wye or delta outputs) make the above adjustments on one phase and then proceed to the next. On delta output models a neutral output-terminal is provided for connecting the test loads from line-neutral rather than line-line. If this is not done, making an adjustment on one phase will effect the other phase/s and vice versa. Be sure to use line-neutral, not line-line, specifications.

3 TROUBLESHOOTING

If the LINE circuit breaker trips, and cannot be reset, the most likely problem is a defective power output stage transistor. Refer to Drawing B-1395, Troubleshooting Procedure drawing.



LOOKING ON TOP OF THE TERMINAL STRIPS OF A TYPICAL POWER OUTPUT STAGE.



CORRESPONDING SCHEMATIC OF COMPONENT LAYOUT SHOWN AT LEFT.

TROUBLESHOOTING PROCEDURE.

1. Defective darlington input transistors. Check B-E, B-C, E-C of Q1 and Q2 with ohmmeter.
2. Connect an ohmmeter* between (1) and (2), and then between (5) and (6). One way reads high, the other low (e.g., from collector through base, R1 and R4.) However, if one output stage consists of two stacks and each stack is located in a different chassis and the cable between chassis is disconnected, then the stack not having the darlington pair will read high both ways between (1) and (2), and (5) and (6). Without interconnecting cable ground connections may be open.
3. Collector to emitter short. Determine if the short is between (2) and (1) or (6) and (5). Connect one ohmmeter lead to the collector buswire and the other lead to each emitter, in turn. Read approx. 1 to 2 ohms. A lower reading indicates the defective transistor. Check both directions, see step 2.
4. Collector to base short. Determine if the short is between (2) and (3) or (6) and (7). (The ohmmeter reads low both ways.) Start cutting the base buswire from each base connection (3) or (7) until the defective transistor is isolated.
5. Emitter to base short. Determine if the short is between (3) and (1) or (7) and (5). It may help to lift the base buswire from R1 and/or R2. Connect one ohmmeter lead to the base buswire (3) or (7) and the other to each emitter, in turn. Since the meter reads through the emitter resistor of a good stage, the shorted transistor will have a near zero reading.

NOTE:

R1 & R2 can be 2 ohm, 1 ohm, or 1 ohm paralleled by 5.1 ohm, depending on number of output transistors. R3 and R4 are 0.5 ohm. The bases (7) & (3) may have green and brown wires, respectively, connected to them. These are interconnecting wires if an output stage consists of two or more individual stacks, but only one darlington pair.

(1) Refers to test points.

Steps 2 to 5 of the troubleshooting procedure refer to power output transistors Q3-4-5-6-.

*Use an analog meter such as the Simpson 260 or 269, or the Triplett 630A.

BEHLMAN 1142 Mark Avenue • Carpinteria, CA 93013
A Flakers Company

DRAWN BY WH	APPROVALS: ENGR:
DATE 8-3-81	Q.A.
TITLE TROUBLE SHOOTING PROCEDURE FOR POWER OUTPUT STAGE	
SIZE B	DRAWING NO. 1395 REV A
	SHEET 1 OF 1

TECHNICAL REFERENCE

BEHLMAN
An Astrosystems Company
6 Nevada Drive
Lake Success, NY 11042

THEORY OF OPERATION

1 ELECTRICAL DESCRIPTION

An electrical signal, anywhere within the frequency range capability of the power amplifier, is generated by a single phase microprocessor-controlled synthesized-sinewave oscillator. This signal is applied to the input of a driver amplifer. The output of the driver is applied to the input of a linear power amplifier. The power amplifier is transformer coupled to the output terminals located on the front and/or rear of the power supply. The output is isolated and can be left floating, or either side may be connected to ground.

In three phase units, a three phase microprocessor is used along with three drivers. The theory of operation remains essentially the same.

A D.C. power supply section converts the A.C. input power to the various D.C. voltage and power levels required by the A.C. generating circuitry.

2 GPIB INTERFACE (OPTIONAL)

The GPIB interface acts as an extension of the front panel keyboard and output load switch. The same characters that appear on the keyboard may be sent over the bus, in ASCII, to set the output frequency and voltage. Seperate bus commands provide control of the other oscillator functions; ie, load ON/OFF, range change and REMOTE/LOCAL change over.

A Texas Instruments (TI) TMS9914 is used to provide the interface function between the GPIB and the A.C. Power Supply microprocessor. TI SN75160 and SN75161 bus transceivers are used to connect the TMS9914 to the GPIB data and management lines.

3 OSCILLATOR

The oscillator is a microprocessor controlled sine wave generator that provides independent control of the amplitude, phase angle of each phase and also control of the output frequency.

3.1 MICROPROCESSOR CARD

The internal microprocessor accepts commands from the keyboard or optional remote interface, decodes them and presents the programming to the oscillator control circuitry. Additionally, the microprocessor monitors the output waveform and reports measurements made on it to the display or optional remote interface.

The microprocessor is a 2MHz Z-80 based system with 12K of PROM and 1K of RAM. Data and commands are sent over a Motherboard arrangement via a full Z-80 I/O port.

Contained on the microprocessor card are the keyboard interface, display interface, 8 bit input port, and an 8 bit output port which are used to send and recieve data to and from the Amplifier and front panel.

3.2 FREQUENCY CARD

The frequency card generates a clock pulse at 360 times the output frequency by repeated dividing of a master clock. An IC and crystal produce a master clock at 18MHz. This clock signal is sent to five cascaded digital rate multipliers. The multiplication value is derived from latched data, programmed by the microprocessor, at the two 8255 ICs'. The rate multipliers effectively give the programmed number of output pulses for every 100,000 master clock pulses, giving a precise output frequency. This output frequency is then fed to a divide by five circuit to smooth out irregularities in the duty cycle. The resulting clock is buffered and is fed, via the Motherboard, to the Voltage card and its synthisization circuity.

Along with the master clock circuit, the Frequency card has provision for a IEEE-488 interface, a bidirectional parallel port interface, and the 0-10 volt frequency programming circuity.

3.3 VOLTAGE CARD

The voltage card contains the sine wave synthesization and amplitude control circuity. The clock signal produced on the Frequency card is fed in to a 360 step down counter. The 10 bit count is presented as addresses to a PROM which contains a lookup table for a 360 step, binary encoded, sine wave. The PROM outputs 360 bytes of data, at the output frequency rate, to a digital to analog converter (DAC). The DAC converts the binary encoded data that represents the sine wave into an analog sine wave. There is one synthesization circuit per phase. Phase separation is accomplished by loading offsets into the down counters of the B and C phases. The reset from the A phase down counter loads the offsets into the down counters for the B and C phases while loading zero into the A phase. This, then, starts the sine lookup address for the Band C phases at their offset values at the same time the A phase address is at zero, producing a phase shift between the phases.

Amplitude programming is accomplished by latching a binary number that represents a percent of full scale amplitude into a DAC. The DAC converts the binary value into an analog progamming voltage. The analog sine wave and the analog programming voltage are used by an analog multiplier IC to give an output sine wave that is amplitude controlled.

The voltage card also has provisions for the 0-10 Volt amplitude programming option.

3.4 MEASUREMENT CARD

The Measurement card collects amplitude, frequency, and current data from different sensors in the power supply and converts it to a form that is readable by the microprocessor. The frequency data is obtained by presenting the oscillator output to a binary counter that is enabled for precise, known intervals. The count, which is directly proportional to the output frequency, is read by the microprocessor and displayed as frequency.

The voltage across the output terminals is measured by applying it to a precision rectifier to produce a DC voltage that is directly proportional to the average output amplitude. This voltage is applied to an analog to digital converter (ADC) which produces a reading for the microprocessor circuitry.

Currents are measured by placing the primary of a toriodal transformer in the power output stage's final output current path. The secondary of the transformer is applied across a known resistance. The resulting voltage is presented to a precision rectifier and ADC as is the voltage measurement signal. The resulting digital output is read by the microprocessor as output current.

4 DRIVER

4.1 GENERAL DESCRIPTION

A single driver is used for each phase. The driver provides push-pull signals, at appropriate voltage and current levels, to the input of the power output stage. The driver also provides output overload short circuit sensing and protection functions.

POSITIVE FEEDBACK REDUCTION WITH LOW POWER FACTOR LOADS:

A method is utilized that increasingly reduces the positive feedback as the load power factor is decreased. This greatly improves the regulation from no-load to full-load when low power factor loads are used. It also greatly increases the margin of stability when using capacitive loads.

The arrangement monitors the difference in phase between the voltage across the load and the current through the load. It then reduces the positive feedback in proportion to the phase difference.

OVERLOAD FUNCTIONS:

Excessive current through the load is reflected as high outputs of source followers Q1 and Q2. These high drive signals turn on Q3 which then loads the inputs to the gates of Q1 and Q2. This reduces the drive voltages, and thereby the output current, to pre-set and safe levels. Clipping of the output voltage results. Reference Figure 5.1.

5 POWER-OUTPUT STAGE

5.1 GENERAL DESCRIPTION

The power-output stage takes low level signals from the driver and amplifies them to the power level required at the output of the A.C. Power Supply.

5.2 ELECTRICAL DESCRIPTION

The power-output stage is a push-pull stage employing transformer coupling between the collectors of NPN power transistors and the load terminals.

Two of the output stage transistors are connected in a darlington configuration. A push-pull signal from the driver is applied to the bases of the darlington transistors, which in turn drive the rest of the output transistors. Up to 30 output transistors may be driven by each darlington pair.

Resistors in the emmtter circuits of each pair of power-output transistors protect against thermal runaway and force each transistor to take its fair share of load current. The number of power-output transistors employed depends upon the power output required of the stage.

An R-C roll-off network is used to provide the necessary margin of stability.

6 D.C. POWER SUPPLY SECTION

6.1 GENERAL DESCRIPTION

D.C. power, of both polarities and at several voltage and current levels, is required for the various stages in the A.C. Power Supply.

$\pm$15, $\pm$5 and +12 VDC regulated is required by the oscillator and optional GPIB interface. +60 Vdc is required by the driver amplifier.

+60 VDC at high current levels is required by the power output stage collectors. On 350-1500 VA models this is a regulated voltage.

A single input power transformer is used. This transformer has a sufficient number of output windings to provide A.C. voltage to the various D.C. power supplies.

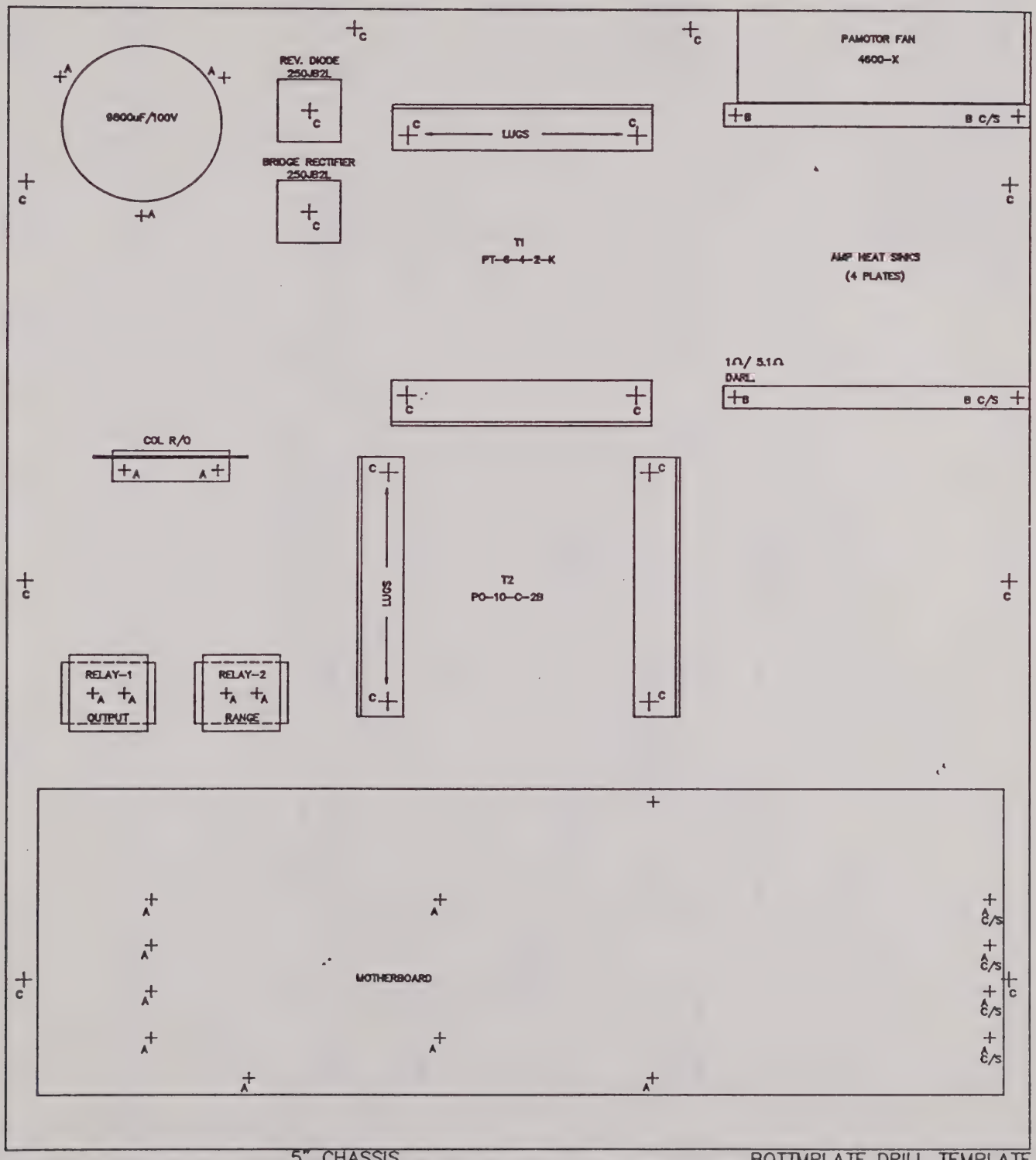
6.2 ELECTRICAL DESCRIPTION

The $\pm$15 and +12 regulated voltages are derived from I.C. regulated bridge-rectifier power supplies. A.C. power for the supplies is taken from winding 7 & 8 on the power input transformer. The $\pm$5 regulated voltages are derived in the same manner from winding 9 & 10.

The +60 unregulated voltage is a filtered bridge-rectifier circuit taken from winding 5 & 6 on the power input transformer. On models with 3 phase input, a set of diode-doublers is used in the same manner.

On 350-1500 VA models the +60 supply uses a switching regulator to improve the efficiency of the power-output stage. The +60 volts is monitored by an op-amp used as a comparator-switch. Variations in the +60 voltage cause the op-amp to turn on the switching transistors when the voltage is too low, and vice-versa. Turning on the switching transistors causes the output filter-capacitor voltage to rise as it receives current from the raw +60 supply. When the voltage rises to the correct level the comparator-switch turns off the switching transistors. Capacitor charging currents are limited by using a reactor. Flyback voltages across this reactor are also channeled into the output capacitor through a diode.

A very fast acting circuit breaker is used to monitor the power output stage collector current. If this current exceeds a predetermined value, the circuit breaker trips and removes all input power to the unit. This circuit breaker provides additional protection to that provided by the instantaneous electronic overload protection.

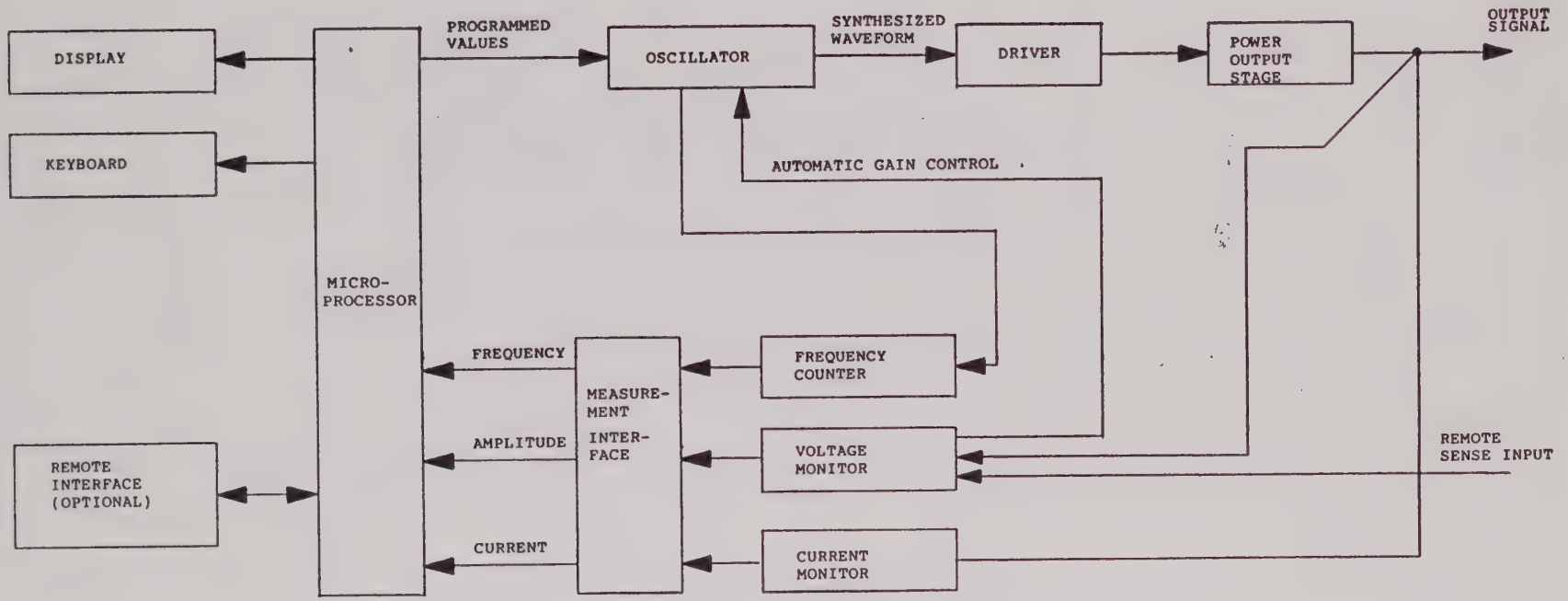


5" CHASSIS
16.625 X 18.625 X .125 ALUM.
GOLD IRIDITE
HOLES: A=#26 DRILL
B=#16 "
C=#6 "

BOTTMPLATE DRILL TEMPLATE
SEV 12-11-87

MODEL: KBT-10-A,B,C,D

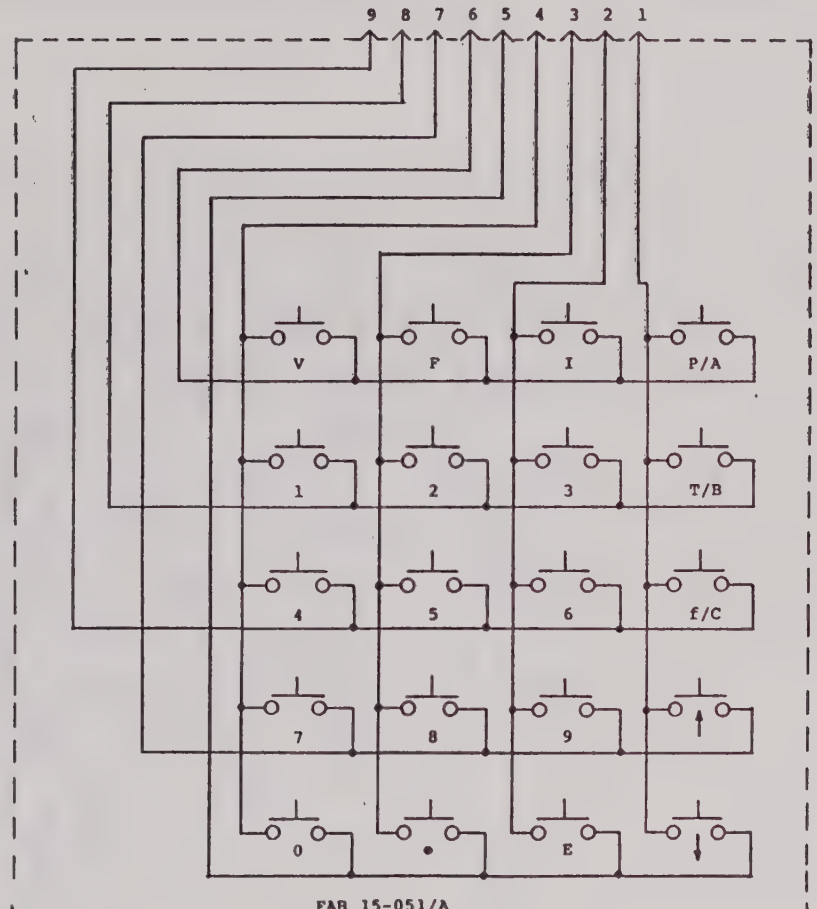
№ 12-120



BEHLMAN 1140 MARK AVENUE · CARPINTERIA, CA 93013

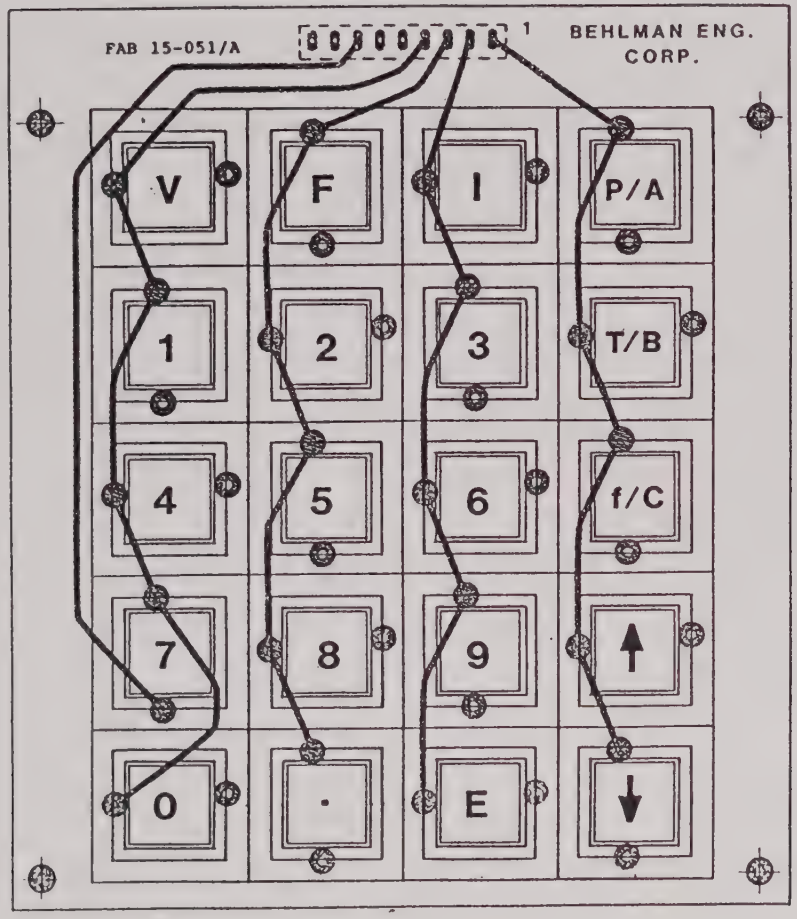
DRAWN BY DB		APPROVALS: ENGRG:	
DATE 9-24-84		Q.A.	
TITLE BLOCK DIAGRAM SHOWING REMOTE AGC SENSE			
MODEL KBT-	SIZE B	DRAWING NO. 2358	REV A
		SHEET 1 OF 1	

BISHOP GRAPHICS/ACCUPRESS REORDER NO A11215



BEHLMAN	1142 MARK AVENUE · CARPINTERIA, CA 93013	
DRAWN BY PLK		APPROVALS: ENGRG: Jay LKill Q.A.
DATE 7-26-85		
TITLE KEYBOARD CONTROL 1Ø AND 3Ø for OPTIONS 360 and 361		
ASSY NO. 16-293 100-495-SCIL	SIZE B	DRAWING NO. 2658 REV A
		SHEET 1 OF 1

BISHOP GRAPHICS/ACCUPRESS RECORDER NO. A11715



BEHLMAN 1148 MARK AVENUE · CARPINTERIA, CA 93013			
DRAWN BY PLK		APPROVALS: ENGRG: Jay L Kill	
DATE 7-26-85		Q.A.	
TITLE KEYBOARD CONTROL 1Ø AND 3Ø for OPTIONS 360 AND 361			
ASSY NO. 16-293 100-495-CMP	SIZE B	DRAWING NO. 2659	REV A
		SHEET 1 OF 1	

BISHOP GRAPHICS/ALTOPRESS REORDER NO A1

PARTS LIST

Description KB FRONT PANEL KEYBOARD

Model KBT/KBT3

Assembly/part no. 16-293

Drawing/ref no. B-2658, B-2659

REF.	DESCRIPTION	MANUFACTURER'S NUMBER	MANUFACTURER
4 pcs	Spacer, Threaded with Stud 4-40, .250"	8216	Smith
20 pcs	Switch, Push Button	82-101-71	Grayhill
1 pc	Printed Circuit Board	15-051/A	Behlman Eng.
1 pc	Contact, Square Pin Single Row 9-position	65593-111	Berg

COMPARENT ITEM 100-351-000 CROSS REF ITEM DESCRIPTION PWA KB MB 1-3PH ENGR DRAW 16.149 QTY 1 ITEM TYPE 2 LOW LEVEL 03 UNIT MEAS EA PLANNER 3

STANDARD BATCH QUANTITY 1.000

LLREF CDNBR	COMPONENT CD	& CROSS REF.	DESCRIPTION & COMMENT	ENGINEERING DRAWING NUMBER	QUANTITY PER	ITEM UM	TYP	OPT NO.	FIRST OP SEQ	LT ADJ	EFFECTIVE DATES FROM	TO
04	OP0026.00		OP COST		1.000	EA	4					
04	100-000-005		SCRW PAN PHLP 6-32X.250	40.012	14.000	EA	4					
05	100-000-006		SCRW PAN PHLP 6-32X.375	40.013	3.000	EA	4					
04	100-001-002		NUT HEX SM PAT 6-32	40.021	15.000	EA	4					
04	100-006-003		WASHR LK SPLIT #6	40.025	3.000	EA	4					
04	100-008-002		WASHR LK INT #6	40.026	12.000	EA	4					
05	100-036-000		LUG SOLDER #6	18.057	12.000	EA	3					
05	100-096-002		SKT IC OPEN FRAME 14PIN	24.002	2.000	EA	4					
04	100-114-000		HTSK TO-220 HORZ	29.016	1.000	EA	4					
04	100-121-000		INSUL SPCR TO-5	29.009	4.000	EA	4					
04	100-147-000		CAP TANT 25V 10UF C9,10	20.133	2.000	EA	4					
04	100-155-000		CAP MONO 50V 2.2UF C7,8,11,12	20.000	4.000	EA	4					
05	100-158-000		CAP MONO 50V 4.7UF C1-6	20.137	6.000	EA	4					
04	100-193-011		RES MTL FLM 1% 1/4W 499 R22-25	21.045	4.000	EA	4					
05	100-193-015		RES MTL FLM 1% 1/4W 1.0K R6,13,20,26-29	21.049	7.000	EA	4					
04	100-193-033		RES MTL FLM 1% 1/4W 4.99K R5,12,19	21.067	3.000	EA	4					
05	100-193-060		RES MTL FLM 1% 1/4W 20.0K R1,3,8,10,15,17	21.091	6.000	EA	4					
04	100-193-109		RES MTL FLM 1% 1/4W 750K R2,4,9,11,16,18	21.147	6.000	EA	4					
04	100-351-CMP		COMPONENT LAYOUT DRAWING	B-1889	.000	EA	9					
04	100-351-REV		BOM REVISION LEVEL J		.000	EA	9					
04	100-351-SCH		SCHEMATIC DRAWING	C-1004	.000	EA	9					
04	100-588-002		RES WW 3W 1.0 R7,14,21	21.009	3.000	EA	4					
05	100-588-007		RES WW 3W 1.0K R30-33	21.254	4.000	EA	4					
04	100-638-000		PWB KB MB 1-3PH	15.076	1.000	EA	4					
04	100-986-000		GUIDE CARD	35.041	8.000	EA	4					
04	100-987-000		BRKT GUIDE CARD	35.042	8.000	EA	4					
05	101-000-000		TERM SLDR FORK	24.009	48.000	EA	4					
04	101-044-000		XFMR TOR 100T 26AWG T1-3 PULL UPON RECEIPT FROM VENDOR	22.038	3.000	EA	4					
04	101-137-000		CONN EGCD PCMNT 44CONT MJ1,2	25.006	2.000	EA	4					
04	101-138-000		CONN EGCD PCMNT 100CONT MJ4-7	25.007	4.000	EA	4					
04	101-207-000		GUIDE CARD .0625 BD	25.040	4.000	EA	4					
04	101-286-001		HEDR PCMNT .1" 1ROW 1CONT PIN	24.008	2.000	EA	4					
05	101-286-009		HEDR PCMNT .1" 1ROW 36CONT PIN 2EA 1 CONT	24.071	.056	EA	4					

COMPARENT ITEM 100-351-000 CROSS REF ITEM DESCRIPTION PWA KB MB 1-3PH ENGR DRAW 16.149 STANDARD BATCH QUANTITY 1.000 QTY 1 ITEM TYPE 2 UNIT MEAS EA LOW LEVEL 03 PLANNER 3

LLREF CDNBR	COMPONENT CD	CROSS REF.	& DESCRIPTION & COMMENT	ENGINEERING DRAWING NUMBER	QUANTITY PER	ITEM UM	TYP	OPT NO.	FIRST OP SEQ	LT ADJ	EFFECTIVE DATES FROM	TO
05	101-288-004		HEDR PCMNT .1" 2ROW 72CONT PIN MJ3 1EA 24 CONT	24.061	.722	EA	4					
05	101-383-000		IC TL084 QUAD OPAMP U1,2	19.016	2.000	EA	4					
04	101-392-000		XSTR 2N3440 NPN 10W 250V 1A Q1-4	19.025	4.000	EA	4					
04	101-401-000		IC 7815CT VREG 15V 1.5A VR1 7815	19.034	1.000	EA	4					
04	101-402-000		IC 7915CT VREG -15V 1.5A VR2 7915	19.035	1.000	EA	4					
04	101-463-000		IC 7805CT VREG +5V 1.5A VR3 7805	19.099	1.000	EA	4					

COMPARENT ITEM CROSS REF ITEM DESCRIPTION PWA KB MPRCS CARD QTY 1 ITEM TYPE 2 LOW LEVEL 03
100-343-000 ENGR DRAW 16.141 UNIT MEAS EA PLANNER 3
STANDARD BATCH QUANTITY 1.000

LLREF CDNBR	COMPONENT CD	CROSS REF.	& DESCRIPTION & COMMENT	ENGINEERING DRAWING NUMBER	QUANTITY PER	ITEM UM	TYP	OPT NO.	FIRST OP SEQ	LT ADJ	EFFECTIVE DATES FROM	TO
04	OP0015.00		OP COST		1.000	EA	4					
05	100-000-006		SCRW PAN PHLP 6-32X.375	40.013	2.000	EA	4					
05	100-001-002		NUT HEX SM PAT 6-32	40.021	2.000	EA	4					
05	100-006-003		WASHR LK SPLIT #6	40.025	2.000	EA	4					
05	100-096-004		SKT IC OPEN FRAME 18PIN ROBINSON NUGENT ICT186STG	24.056	1.000	EA	4					
05	100-096-005		SKT IC OPEN FRAME 24PIN ROBINSON NUGENT ICT246STG	24.004	4.000	EA	4					
04	100-096-006		SKT IC OPEN FRAME 20PIN ROBINSON NUGENT ICT203STG	24.070	1.000	EA	4					
04	100-096-007		SKT IC OPEN FRAME 40PIN ROBINSON NUGENT ICT4069STG	24.057	1.000	EA	4					
05	100-114-000		HTSK TO-220 HORZ THERMALLOY 6070B	29.016	2.000	EA	4					
04	100-128-012		CAP MICA 500V 33PF C1,2	20.055	2.000	EA	4					
05	100-149-000		CAP TANT 35V 10UF C22-25	20.143	4.000	EA	4					
05	100-154-000		CAP MONO 50V .10UF C3-19	20.007	17.000	EA	4					
05	100-155-000		CAP MONO 50V 2.2UF C20	20.008	1.000	EA	4					
05	100-161-000		CAP MONO 50V 1.0UF C30	20.041	1.000	EA	4					
05	100-193-002		RES MTL FLM 1% 1/4W 100 OHMS R10-36,38-41 MEPCO RN55D1000F	21.036	31.000	EA	4					
04	100-193-011		RES MTL FLM 1% 1/4W 499 R60-67 MEPCO RN55D4990F	21.045	8.000	EA	4					
05	100-193-015		RES MTL FLM 1% 1/4W 1.0K R1,4,5,7,50,53 MEPCO RN55D1001F	21.049	6.000	EA	4					
05	100-193-033		RES MTL FLM 1% 1/4W 4.99K R3,6 MEPCO RN55D4991F	21.067	2.000	EA	4					
04	100-193-131		RES MTL FLM 1% 1/4W 200 R8,9,37,42-49 MEPCO RN55D2000F	21.251	11.000	EA	4					
04	100-193-134		RES MTL FLM 1% 1/4W 15 R2 MEPCO RN55D15R0F	21.281	1.000	EA	4					
04	100-343-CMP		COMP LAYOUT	B-5387-B	.000	EA	9					
04	100-343-REV		BOM REVISION LEVEL C		.000	EA	9					
04	100-343-SCH		SCHEMATIC	B-5386-B	.000	EA	9					
04	100-598-004		RES NETWRK SIP 5.6K RP1,2 BOURNS 4310R-101-562	21.244	2.000	EA	4					

COMPARENT ITEM CROSS REF ITEM DESCRIPTION PWA KB MPRCS CARD QTY 1 ITEM TYPE 2 LOW LEVEL 03
100-343-000 ENGR DRAW 16.141 UNIT MEAS EA PLANNER 3
STANDARD BATCH QUANTITY 1.000

LLREF CDNBR	COMPONENT CD CROSS REF.	DESCRIPTION & COMMENT	ENGINEERING DRAWING NUMBER	QUANTITY PER	ITEM UM TYP	OPT NO.	FIRST OP SEQ	LT ADJ	EFFECTIVE DATES FROM	TO
04	101-173-000	HEDR PCMNT RTANG 26CONT J2	25.084	1.000	EA 4					
04	101-287-003	HEDR PCMNT 1ROW 36CONT PIN J1 - 10 CONTACT J3 - 9 CONTACT J6 - 2 CONTACT	24.060	.583	EA 4					
04	101-437-000	IC SCHTKY QUAD 2-I/P NAND U19 NATIONAL 74LS00	19.072	1.000	EA 4					
05	101-463-000	IC VREG 1.5A +5VDC VR1,3 MOTOROLA MC7805CT	19.099	2.000	EA 4					
04	101-467-000	IC CPU 280 U10 ZILOG Z8400	19.103	1.000	EA 4					
04	101-479-000	IC OCTAL BUSS TRANSCEIVER U9,11,12,15,18,21,25,27 NATIONAL 74LS245	19.115	8.000	EA 4					
05	101-487-000	IC EPROM 4KX8 BIT U7,8,14 INTEL D2732A	19.123	3.000	EA 4					
04	101-491-000	IC DGTL ITL DECODER KEY U26 NATIONAL 74C923	19.126	1.000	EA 4					
04	101-493-000	IC DUAL GATE HEX INVTR 74LS14 U4,20 NATIONAL 74LS14	19.128	2.000	EA 4					
04	101-495-000	IC QUAD 2-I/P NOR 74LS32 U3 NATIONAL 74LS32	19.130	1.000	EA 4					
05	101-496-000	IC 1 OF 10 DECODER 74LS42 U2,16,17 NATIONAL 74LS42	19.131	3.000	EA 4					
04	101-497-000	IC DUAL FLIP FLOP 74LS74 U28 NATIONAL 74LS74	19.132	1.000	EA 4					
05	101-501-000	IC 3-ST OCTAL FLP-FLP 74LS374 U23 NATIONAL 74LS374	19.136	1.000	EA 4					
04	101-514-000	XSTAL 4.00MHZ Y1 CRYSTEK CY3A4MHZ	19.149	1.000	EA 4					
04	103-337-000	PWB KB UP MULTILAYER	15.142 B-5307-B	1.000	EA 4					
04	103-406-000	IC CLK GEN & CNTL 8581 U1	19.278	1.000	EA 4					
04	103-407-000	IC RAM 6116 U13 HITACHI HM6116P	19.279	1.000	EA 4					

COMPARENT ITEM	CROSS REF ITEM	DESCRIPTION PWA KB MPRCS CARD	QTY	1	ITEM TYPE	2	LOW LEVEL	03
100-343-000		ENGR DRAW 16.141			UNIT MEAS	EA	PLANNER	3
		STANDARD BATCH QUANTITY 1.000						

LLREF CDNBR	COMPONENT CD	& CROSS REF.	DESCRIPTION & COMMENT	ENGINEERING DRAWING NUMBER	QUANTITY PER	ITEM UM	TYP	OPT NO.	FIRST OP SEQ	LT ADJ	EFFECTIVE DATES FROM	TO
04	103-788-000		IC DUAL 4 I/P NAND 74LS20 U5 NATIONAL 74LS20	19.287	1.000	EA	4					

COMPARENT ITEM CROSS REF ITEM DESCRIPTION PWA KB FREQ CARD LO-$ W/O -386 QTY 1 ITEM TYPE 2 LOW LEVEL 03
103-652-000 ENGR DRAW 16.463 UNIT MEAS EA PLANNER 3
STANDARD BATCH QUANTITY 1.000

LLREF CDNBR	COMPONENT CD	& CROSS REF.	DESCRIPTION & COMMENT	ENGINEERING DRAWING NUMBER	QUANTITY PER	ITEM UN	TYP	OPT NO.	FIRST OP SEQ	LT ADJ	EFFECTIVE DATES FROM	TO
04	OP0019.25		OP COST		1.000	EA	4					
05	100-000-006		SCRW PAN PHLP 6-32X.375	40.013	4.000	EA	4					
04	100-001-002		NUT HEX SM PAT 6-32	40.021	4.000	EA	4					
04	100-006-003		WASHR LK SPLIT #6	40.025	4.000	EA	4					
04	100-096-006		SKT IC OPEN FRAME 20PIN 20S TSD	24.070 CA	2.000	EA	4					
04	100-096-007		SKT IC OPEN FRAME 40PIN 40STSD	24.057 CINCH	3.000	EA	4					
04	100-114-000		HTSK TO-220 HORZ 6070B	29.016 THERMALLOY	2.000	EA	4					
04	100-128-005		CAP MICA 500V 10PF C35 CMOSED100J03	20.048 CDE	1.000	EA	4					
04	100-147-000		CAP TANT 25V 10UF C10,23,32,33 199D10620025CB1	20.133 SPRAGUE	4.000	EA	4					
04	100-152-000		CAP TRIMMER CERMET 6-70PF C34 6KJ70000	20.134 SPRAGUE	1.000	EA	4					
04	100-154-000		CAP MONO 50V .10UF C1-9,11,29,30 SR20SE104MAA	20.007 AVX	12.000	EA	4					
04	100-193-007		RES MTL FLM 1% 1/4W 332 R33 RN55D 3320F	21.041	1.000	EA	4					
04	100-193-011		RES MTL FLM 1% 1/4W 499 R34 RN55D 4990F	21.045	1.000	EA	4					
05	100-193-051		RES MTL FLM 1% 1/4W 10.0K R35 RN55D 1002F	21.082	1.000	EA	4					
04	100-598-004		RES NETWRK SIP 5.6K R1 4310R-101-562	21.244 BOURNS	1.000	EA	4					
04	100-648-000		PWB KB DGTL FREQ CARD FAB 15-089	15.089 BEHLMAN	1.000	EA	4					
04	101-174-000		HEDR PCMNT RTANG 34CONT J1 609-3407	25.085 ANSLEY	1.000	EA	4					
04	101-437-000		IC 74LS00 QUAD 2-I/P NAND U15 74LS00	19.072 MOTOROLA	1.000	EA	4					
04	101-438-000		IC 74LS75 4BIT D-TYPE LATCH U18 74LS75	19.073 MOTOROLA	1.000	EA	4					
04	101-456-000		IC 74LS367 HEX 3-STATE BUFFER U4,19 74LS367	19.092 MOTOROLA	2.000	EA	4					

COMPARENT ITEM 103-652-000 CROSS REF ITEM DESCRIPTION PWA KB FREQ CARD LO-$ W/O -386 ENGR DRAW 16.463 STANDARD BATCH QUANTITY 1.000 QTY 1 ITEM TYPE 2 UNIT MEAS EA LOW LEVEL 03 PLANNER 3

LLREF CDNBR	COMPONENT CD	CROSS REF.	& DESCRIPTION & COMMENT	ENGINEERING DRAWING NUMBER	QUANTITY PER	ITEM UM	TYP	OPT NO.	FIRST OP SEQ	LT ADJ	EFFECTIVE DATES FROM	TO
04	101-460-000		IC TMS9914 IEEE488 INTERFACE	19.096	1.000	EA	4					
			U3									
			TMS 9914ANL	TI								
04	101-461-000		IC 75161 GPIB LINE TRANCEIVER	19.097	1.000	EA	4					
			U2									
			SN75161	MOTOROLA								
04	101-463-000		IC 7805CT VREG +5V 1.5A	19.099	2.000	EA	4					
			VR3,6									
			MC7805CT	MOTOROLA								
04	101-465-000		IC 75160 GPIB LINE TRANCEIVER	19.101	1.000	EA	4					
			U1									
			SN75160	MOTOROLA								
04	101-479-000		IC 74LS245 BIDIR BUSS XCEIVER	19.115	1.000	EA	4					
			U5									
			74LS245	MOTOROLA								
04	101-495-000		IC 74LS32 QUAD 2-INPUT OR	19.130	2.000	EA	4					
			U6,16									
			74LS32	MOTOROLA								
04	101-496-000		IC 74LS42 1 OF 10 DECODER	19.131	2.000	EA	4					
			U12,14									
			74LS42	MOTOROLA								
04	101-523-000		IC 8255A PROGRAMABLE I/O INTFC	19.158	2.000	EA	4					
			U8,10									
			AM8255A	AMD								
04	101-524-000		IC 74LS90 DECADE COUNTER	19.159	1.000	EA	4					
			U13									
			74LS90	TI								
04	101-525-000		IC 74167 DECADE RATE MULT	19.160	5.000	EA	4					
			U17,20,21,23,24									
			74167	TI								
04	101-526-000		IC 74S124 DUAL VOLT CNTLD OSC	19.161	1.000	EA	4					
			U22									
			74S124	TI								
04	101-527-000		XTAL NMP180 18.000MHZ	19.162	1.000	EA	4					
			Y1									
			18.000 NMP-180	JK								
04	103-652-CMP		COMP LAYOUT	B-5368-B	.000	EA	9					
04	103-652-REV		BOM REVISION LEVEL B		.000	EA	9					
04	103-652-SCH		SCHEMATIC	B-5352-A	.000	EA	9					

COMPARENT ITEM CROSS REF ITEM DESCRIPTION PWA KB MEASMT CARD 1PH QTY 1 ITEM TYPE 2 LOW LEVEL 03
100-392-000 ENGR DRAW 16.189 UNIT MEAS EA PLANNER 3
STANDARD BATCH QUANTITY 1.000

LLREF CDNBR	COMPONENT CD	CROSS REF.	& DESCRIPTION & COMMENT	ENGINEERING DRAWING NUMBER	QUANTITY PER	ITEM UM	TYP	OPT NO.	FIRST OP SEQ	LT ADJ	EFFECTIVE DATES FROM	TO
04	OP0022.25		OP COST		1.000	EA	4					
05	100-000-006		SCRW PAN PHLP 6-32X.375	40.013	3.000	EA	4					
04	100-001-002		NUT HEX SM PAT 6-32	40.021	3.000	EA	4					
04	100-006-003		WASHR LK SPLIT #6	40.025	3.000	EA	4					
05	100-096-002		SKT IC OPEN FRAME 14PIN	24.002	2.000	EA	4					
04	100-096-005		SKT IC OPEN FRAME 24PIN	24.004	1.000	EA	4					
04	100-114-000		HTSK TO-220 HORZ	29.016	1.000	EA	4					
04	100-128-009		CAP MICA 500V 24PF C1,2	20.052	2.000	EA	4					
05	100-128-020		CAP MICA 500V 68PF C33	20.063	1.000	EA	4					
04	100-128-031		CAP MICA 500V 270PF C31	20.074	1.000	EA	4					
04	100-128-032		CAP MICA 500V 300PF C5,7	20.075	2.000	EA	4					
04	100-147-000		CAP TANT 25V 10UF C14,17,35-40	20.133	8.000	EA	4					
04	100-154-000		CAP MONO 50V .10UF C32,34,41-67	20.007	29.000	EA	4					
04	100-155-000		CAP MONO 50V 2.2UF C3,6,8,13,15,16,18	20.008	7.000	EA	4					
05	100-161-000		CAP MONO 50V 1.0UF C68,69	20.041	2.000	EA	4					
05	100-193-002		RES MTL FLM 1% 1/4W 100 OHMS R91	21.036	1.000	EA	4					
05	100-193-006		RES MTL FLM 1% 1/4W 261 R89,92	21.040	2.000	EA	4					
05	100-193-015		RES MTL FLM 1% 1/4W 1.0K R6,11,15,46,48,49,81,97	21.049	8.000	EA	4					
04	100-193-017		RES MTL FLM 1% 1/4W 1.24K R100	21.051	1.000	EA	4					
04	100-193-019		RES MTL FLM 1% 1/4W 1.82K R9	21.053	1.000	EA	4					
04	100-193-021		RES MTL FLM 1% 1/4W 2.21K R5	21.055	1.000	EA	4					
05	100-193-025		RES MTL FLM 1% 1/4W 3.01K R14	21.059	1.000	EA	4					
05	100-193-051		RES MTL FLM 1% 1/4W 10.0K R2,7,12,54-59	21.082	9.000	EA	4					
05	100-193-060		RES MTL FLM 1% 1/4W 20.0K R3,4,16,17,22-25,34,35,40,41,86,87	21.091	14.000	EA	4					
05	100-193-066		RES MTL FLM 1% 1/4W 30.1K R80 SELECT AT TEST	21.097	1.000	EA	4					
04	100-193-067		RES MTL FLM 1% 1/4W 33.2K R8	21.098	1.000	EA	4					
05	100-193-092		RES MTL FLM 1% 1/4W 100K R47,96,98,101,102	21.125	5.000	EA	4					
04	100-193-093		RES MTL FLM 1% 1/4W 110K R103	21.126	1.000	EA	4					

COMPARENT ITEM CROSS REF ITEM DESCRIPTION PWA KB MEASMT CARD 1PH QTY 1 ITEM TYPE 2 LOW LEVEL 03
100-392-000 ENGR DRAW 16.189 UNIT MEAS EA PLANNER 3
STANDARD BATCH QUANTITY 1.000

LLREF CDNBR	COMPONENT CD	CROSS REF.	& DESCRIPTION & COMMENT	ENGINEERING DRAWING NUMBER	QUANTITY PER	ITEM UM	TYP	OPT NO.	FIRST OP SEQ	LT ADJ	EFFECTIVE DATES FROM	TO
04	100-193-094		RES MTL FLM 1% 1/4W 121K R13	21.127	1.000	EA	4					
04	100-193-103		RES MTL FLM 1% 1/4W 402K R93	21.136	1.000	EA	4					
04	100-193-132		RES MTL FLM 1% 1/4W 536K R98	21.252	1.000	EA	4					
04	100-193-133		RES MTL FLM 1% 1/4W 10M R1	21.262	1.000	EA	4					
04	100-392-CMP		COMPONENT LAYOUT	B-2050	.000	EA	9					
04	100-392-REV		BOM REVISION LEVEL E		.000	EA	9					
04	100-392-SCH		SCHEMATIC DRAWING	B-1868	.000	EA	9					
04	100-598-004		RES NETWRK SIP 5.6K R99	21.244	1.000	EA	4					
04	100-634-000		PWB KB MEAS CARD 3PH	15.072	1.000	EA	4					
04	100-828-005		POT TRIM 20T HORZ 25K R72,73,78,79,95	21.240	5.000	EA	4					
05	101-286-009		HEDR PCMNT .1" 1ROW 36CONT PIN TP1,TS1 1EA 1 CONT 1EA 7CONT	24.071	.200	EA	4					
05	101-368-000		DIODE 1N914 100V 20MA D1-7,17	19.001	8.000	EA	4					
04	101-375-000		IC CA3140T BIMOS OP-AMP U16	19.008	1.000	EA	4					
05	101-383-000		IC TL084 QUAD OPAMP U23,26,33	19.016	3.000	EA	4					
04	101-401-000		IC 7815CT VREG 15V 1.5A VR2	19.034	1.000	EA	4					
04	101-402-000		IC 7915CT VREG -15V 1.5A VR3	19.035	1.000	EA	4					
04	101-403-000		DIODE 1N4733A ZENER 1W 5.1V Z2,3	19.036	2.000	EA	4					
04	101-404-000		DIODE 1N4742A ZENER 1W 12V Z5	19.037	1.000	EA	4					
04	101-437-000		IC 74LS00 QUAD 2-I/P NAND U9,22	19.072	2.000	EA	4					
04	101-438-000		IC 74LS75 4BIT D-TYPE LATCH U4	19.073	1.000	EA	4					
04	101-446-000		IC 4046B PHASE-LOCKED LOOP U17,20	19.082	2.000	EA	4					
04	101-447-000		IC 4049 INVERTING HEX BUFFER U19	19.083	1.000	EA	4					
04	101-450-000		IC 4518B DUAL SYNC UP-COUNTER U18,21	19.086	2.000	EA	4					
04	101-453-000		IC 74LS02 QUED 2-INPUT NOR U3	19.089	1.000	EA	4					
04	101-455-000		IC 74LS193 BIN UP/DN COUNTER U5-8	19.091	4.000	EA	4					
04	101-456-000		IC 74LS367 HEX 3-STATE BUFFER U31	19.092	1.000	EA	4					

COMPARENT ITEM 100-392-000 CROSS REF ITEM DESCRIPTION PWA KB MEASMT CARD 1PH ENGR DRAW 16.189 STANDARD BATCH QUANTITY 1.000 QTY 1 ITEM TYPE 2 UNIT MEAS EA LOW LEVEL 03 PLANNER 3

LLREF CDNBR	COMPONENT CD	& CROSS REF.	DESCRIPTION & COMMENT	ENGINEERING DRAWING NUMBER	QUANTITY PER	ITEM UM	TYP	OPT NO.	FIRST OP SEQ	LT ADJ	EFFECTIVE DATES FROM	TO
04	101-459-000		IC ADCET12BC 12-BIT A/D CNVTR	19.095	1.000	EA	4					
		U29										
04	101-463-000		IC 7805CT VREG +5V 1.5A	19.099	1.000	EA	4					
		VR1										
04	101-474-000		IC 4066 QUAD BILATERAL SWITCH	19.110	2.000	EA	4					
		U27,28										
04	101-478-000		IC 74LS244 OCTAL LINE DRIVER	19.114	1.000	EA	4					
		U32										
04	101-489-000		IC ICH7207A FREQ COUNTER	19.125	1.000	EA	4					
		U1										
04	101-494-000		IC 74LS30 8 INPUT NAND	19.129	2.000	EA	4					
		U14,15										
04	101-496-000		IC 74LS42 1 OF 10 DECODER	19.131	2.000	EA	4					
		U10,11										
04	101-500-000		IC 74LS373 3-STATE OCTAL LATCH	19.135	2.000	EA	4					
		U12,13										
04	101-501-000		IC 74LS374 3ST OCTAL FLIP/FLOP	19.136	1.000	EA	4					
		U30										
04	101-506-000		XTAL SRX1092 5.24288MHZ	19.141	1.000	EA	4					
		Y1										
04	101-530-000		IC LM299H VREF TEMP CNTRLD 7V	19.165	1.000	EA	4					
		Z4										

COMPARENT ITEM 100-382-000 CROSS REF ITEM DESCRIPTION PWA KB V CARD 1PH ENGR DRAW 16.179 QTY 1 ITEM TYPE 2 LOW LEVEL 03 UNIT MEAS EA PLANNER 3

STANDARD BATCH QUANTITY 1.000

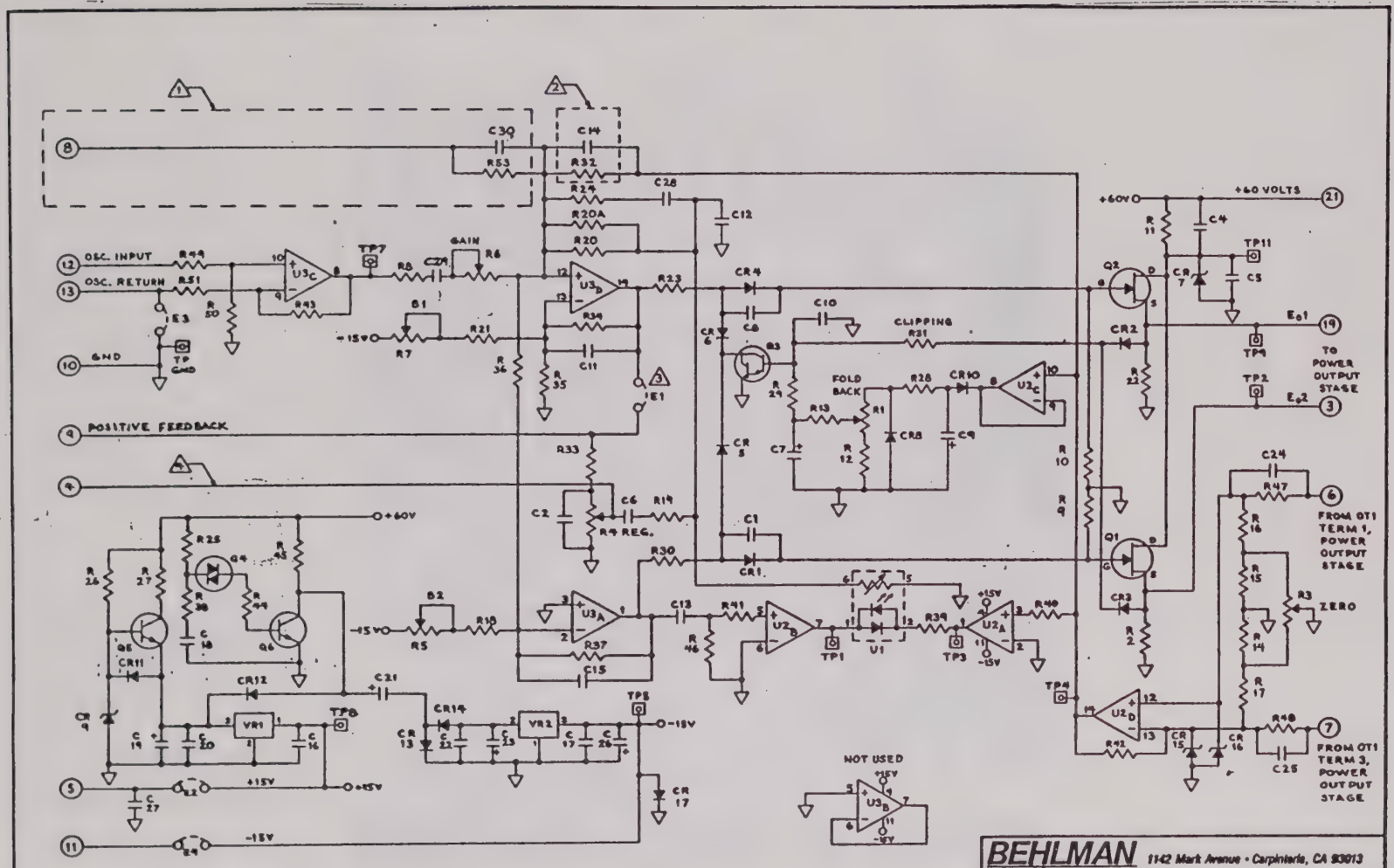
LLREF CDNBR	COMPONENT CD	CROSS REF.	DESCRIPTION & COMMENT	ENGINEERING DRAWING NUMBER	QUANTITY PER	ITEM UM	TYP	OPT NO.	FIRST OP SEQ	LT ADJ	EFFECTIVE DATES FROM	TO
04	OP0015.15		OP COST		1.000	EA	4					
05	100-000-006		SCRW PAN PHLP 6-32X.375	40.013	4.000	EA	4					
04	100-001-002		NUT HEX SM PAT 6-32	40.021	4.000	EA	4					
04	100-006-003		WASHR LK SPLIT #6	40.025	4.000	EA	4					
05	100-096-002		SKT IC OPEN FRAME 14PIN	24.002	1.000	EA	4					
04	100-096-004		SKT IC OPEN FRAME 18PIN	24.056	2.000	EA	4					
04	100-096-005		SKT IC OPEN FRAME 24PIN	24.004	1.000	EA	4					
04	100-114-000		HTSK TO-220 HORZ	29.016	2.000	EA	4					
04	100-128-018		CAP MICA 500V 56PF	20.061	2.000	EA	4					
			C64,65									
			CM05ED560J03	CDE								
04	100-128-025		CAP MICA 500V 120PF	20.068	1.000	EA	4					
			C66									
			CM05FD121J03	CDE								
04	100-128-028		CAP MICA 500V 200PF	20.071	1.000	EA	4					
			C67									
			**USED AS REQUIRED, VALUE MAY VARY WITH APPLICATION.									
			CM05FD201J03	CDE								
04	100-147-000		CAP TANT 25V 10UF	20.133	8.000	EA	4					
			C1-8									
			99D106X0025C31	SPRAGUE								
04	100-154-000		CAP MONO 50V .10UF	20.007	15.000	EA	4					
			C15,16,38,39,41,46-48,51-53,56,57,60,61									
			SR205E104MAA	AVX								
04	100-155-000		CAP MONO 50V 2.2UF	20.008	3.000	EA	4					
			C21,32									
			*27 NOMINAL VALUE, MAY VARY WITH APPLICATION.									
			3C37Z5U225M05B	SPRAGUE								
05	100-161-000		CAP MONO 50V 1.0UF	20.041	5.000	EA	4					
			C9,18,24,31,34									
			5CZU105X0050C5	SPRAGUE								
04	100-193-014		RES MTL FLM 1% 1/4W 825	21.048	1.000	EA	4					
			R49									
			RN55D 8250F									
05	100-193-015		RES MTL FLM 1% 1/4W 1.0K	21.049	5.000	EA	4					
			R20,50,55,56,72									
			RN55D 1001F									
04	100-193-017		RES MTL FLM 1% 1/4W 1.24K	21.051	1.000	EA	4					
			R11									
			RN55D 1241F									
04	100-193-023		RES MTL FLM 1% 1/4W 2.55K	21.057	3.000	EA	4					
			R8,51,68									
			RN55D 2551F									
04	100-193-033		RES MTL FLM 1% 1/4W 4.99K	21.067	3.000	EA	4					
			R17*,59**,71									
			*NOMINAL VALUE, MAY VARY W/APPLICATION									
			**USED AS REQ., VALUE MAY VARY W/ APPLIC.									

COMPARENT ITEM 100-382-000 CROSS REF ITEM DESCRIPTION PWA KB V CARD 1PH ENGR DRAW 16.179 QTY 1 ITEM TYPE 2 LOW LEVEL 03 UNIT MEAS EA PLANNER 3
STANDARD BATCH QUANTITY 1.000

LLREF CDNBR	COMPONENT CD	& CROSS REF.	DESCRIPTION & COMMENT	ENGINEERING DRAWING NUMBER	QUANTITY PER	ITEM UM	TYP	OPT NO.	FIRST OP SEQ	LT ADJ	EFFECTIVE DATES FROM	TO
05	100-193-034		RES MTL FLM 1% 1/4W 5.11K R2 RN55D 5111K	21.068	1.000	EA	4					
04	100-193-046		RES MTL FLM 1% 1/4W 8.25K R32 RN55D 8215F	21.077	1.000	EA	4					
05	100-193-051		RES MTL FLM 1% 1/4W 10.0K R26,38,48,65 RN55D 1002F	21.082	4.000	EA	4					
05	100-193-054		RES MTL FLM 1% 1/4W 13.7K *R44 *NOMINAL VALUE, MAY VARY W/APPLICATION. RN55D 1372F	21.085	1.000	EA	4					
04	100-193-058		RES MTL FLM 1% 1/4W 17.8K *R62 *NOMINAL VALUE, MAY VARY W/ APPLICATION. RN55D 1782F	21.089	1.000	EA	4					
05	100-193-066		RES MTL FLM 1% 1/4W 30.1K R35,41 RN55D 3012F	21.097	2.000	EA	4					
04	100-193-099		RES MTL FLM 1% 1/4W 221K *R14 *NOMINAL VALUE, MAY VARY WITH APPLICATION.	21.132	1.000	EA	4					
04	100-382-CMP		COMPONENT LAYOUT DRAWING	B-2037	.000	EA	9					
04	100-382-REV		BOM REVISION LEVEL E		.000	EA	9					
04	100-382-SCH		SCHEMATIC DRAWING	B-1859	.000	EA	9					
04	100-632-000		PWB KB V CARD 3PH	15.070	1.000	EA	4					
05	100-828-004		POT TRIM 20T HORZ 5.0K R23,29 89PR5K	21.239 BECKMAN	2.000	EA	4					
04	100-828-005		POT TRIM 20T HORZ 25K *R5, R52 *NOMINAL VALUE, MAY VARY WITH APPLICATION.	21.240	2.000	EA	4					
05	101-286-009		HEDR PCMNT .1" 1ROW 36CONT PIN TS1 5 COUNT TS4 12 COUNT	24.071	.472	EA	4					
04	101-375-000		IC CA3140T BIMOS OP-AMP U48 CA 3140T	19.008	1.000	EA	4					
05	101-383-000		IC TL084 QUAD OPAMP U24,33	19.016	2.000	EA	4					
04	101-401-000		IC 7815CT VREG 15V 1.5A VR3 MC7815CT	19.034	1.000	EA	4					

PARENT ITEM 100-382-000 CROSS REF ITEM DESCRIPTION PWA KB V CARD 1PH ENGR DRAW 16.179 STANDARD BATCH QUANTITY 1.000 QTY 1 ITEM TYPE 2 LOW LEVEL 03 UNIT MEAS EA PLANNER 3

LLREF CDNBR	COMPONENT CD	& CROSS REF.	DESCRIPTION & COMMENT	ENGINEERING DRAWING NUMBER	QUANTITY PER	ITEM UM	TYP	OPT NO.	FIRST OP SEQ	LT ADJ	EFFECTIVE DATES FROM	TO
04	101-402-000		IC 7915CT VREG -15V 1.5A	19.035	1.000	EA	4					
			VR4									
			MC7915CT									
04	101-418-000		XSTR 2N3904 NPN 40V .2A	19.051	1.000	EA	4					
			Q1									
			2N3904	MOTOROLA								
04	101-455-000		IC 74LS193 BIN UP/DN COUNTER	19.091	3.000	EA	4					
			U6-8									
			74LS193									
04	101-458-000		IC AD7521 12-BIT MULT DAC	19.094	1.000	EA	4					
			U41									
			7521									
04	101-463-000		IC 7805CT VREG +5V 1.5A	19.099	2.000	EA	4					
			VR1,2									
			MC7805CT									
04	101-478-000		IC 74LS244 OCTAL LINE DRIVER	19.114	1.000	EA	4					
			U40									
			74LS244									
04	101-484-000		IC 4214A ANALOG MULTIPLIER	19.129	1.000	EA	4					
			U30									
			4214AP									
04	101-487-000		IC 2732A EPROM 4KX8 250NS	19.123	1.000	EA	4					
			U15									
			D2732									
04	101-488-000		IC HI5618-5 8BIT HI-SPEED D/A	19.124	1.000	EA	4					
			U21									
			HI-1-5618A-5									
04	101-496-000		IC 74LS42 1 OF 10 DECODER	19.131	1.000	EA	4					
			U45									
04	101-498-000		IC 74LS154 4-16 LINE DECODER	19.133	1.000	EA	4					
			U46									
04	101-499-000		IC 74LS175 QUAD D FLIP/FLOP	19.134	1.000	EA	4					
			U34									
04	101-501-000		IC 74LS374 3ST OCTAL FLIP/FLOP	19.136	2.000	EA	4					
			U18,37									
04	101-502-000		IC MP7512DIJ 2 SPDT ANLOG SWCH	19.137	1.000	EA	4					
			U27									
			MP7512									
04	101-520-000		IC 74121 MONOSTABLE MULTIVIB	19.155	1.000	EA	4					
			U5									
			74121									
04	101-521-000		IC 74LS132 4XSCHMITT 2INP NAND	19.156	2.000	EA	4					
			U44,47									
			74LS132									
04	101-530-000		IC LM299H VREF TEMP CNTRLD 7V	19.165	1.000	EA	4					
			Z1									
			LM299									
04	101-627-000		BUSS BAR 2COND	30.072	3.000	EA	4					
			BB1-3									



⚠4 ADD IF NECESSARY FOR OPTION 341.

⚠3 ALL "E" JUMPERS SELECTED AT TEST.

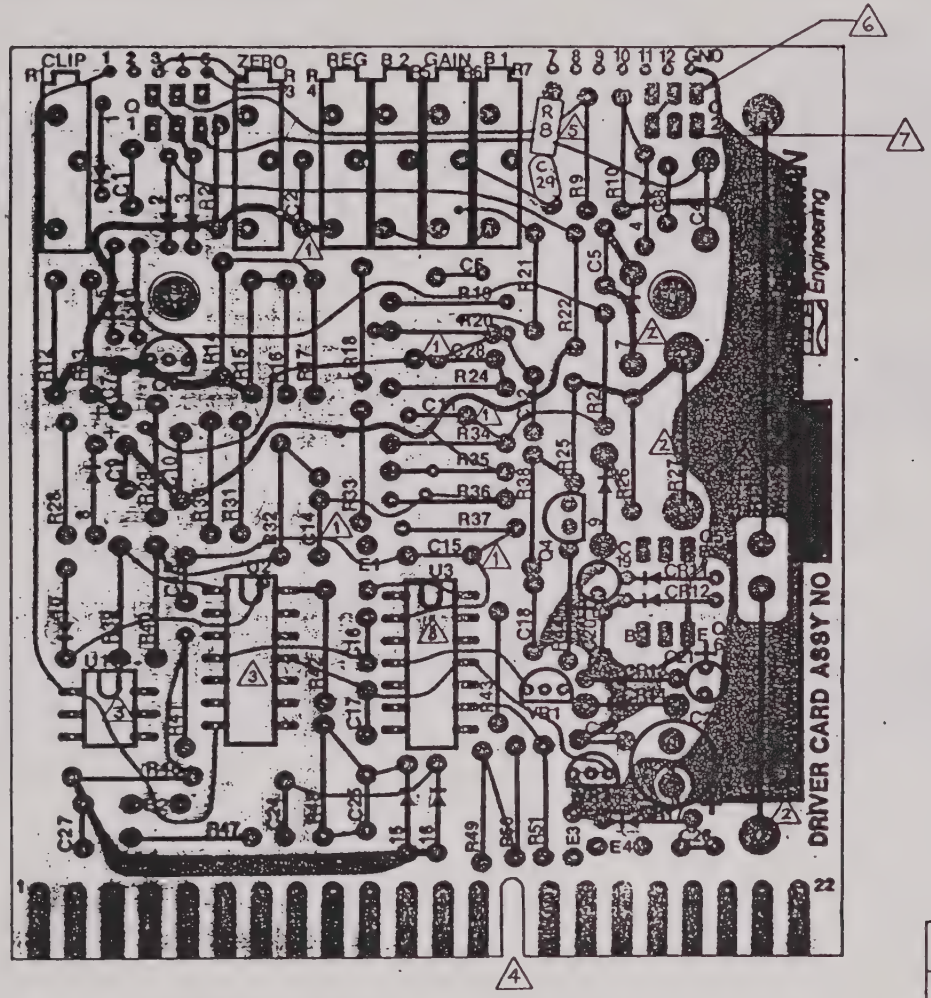
⚠2 C14, R32 MUST BE REMOVED FOR EXT. NEG. FEEDBACK UNITS.

⚠1 C30, R53 MUST BE ADDED AND NOTE ⚠4 ENFORCED FOR EXT. NEG. FEEDBACK UNITS.

NOTES: (INSTALLED AT TEST ON BOARD COMPONENT SIDE)

BEHLMAN 1142 Mark Avenue • Carpinteria, CA 93013
A Fisher Company

DRAWN BY: PLK	APPROVALS: ENGR'G: Jack Kibbe
DATE: 1-11-86	Q.A.:
TITLE: DRIVER, SCHEMATIC	
ASSY NO.: 16-001	SIZE: B
DRAWING NO.: 1274	REV: D
SHEET 1 OF 1	



7 LOWER PADS FOR FET 2SK213,2PL (Q1 & Q2)

6 UPPER PADS FOR FET VN88AF, 2PL (Q1 & Q2)

5 R8, C29 INSTALLED IN SERIES

4 KEY NOTCH AT CONTACT 14

3 SOCKET REQUIRED

2 R11, R45, R27, AND CR7 RAISED 1/8"-3/16" OFF BOARD.

1 C2, C11, C14, C15, AND C28 USED AS REQUIRED

NOTES:

NEXT ASSY	USED ON
APPLICATION	

BEHLMAN 1148 MARK AVENUE - CARPINTERIA, CA

DRAWN BY PLK	APPROVALS: ENGRG: Jack Kilb
DATE 3-7-86	Q.A.
TITLE COMPONENT LAYOUT - DRIVER	
ASSY NO. 16-001 100-194-CMP	SIZE B
DRAWING NO. 2030	
SHEET 1 OF 1	

SCARAB GRAPHICS NO. 83746

BEHLMAN ENG. SINGLE LEVEL BILL WITH BLOW-THRU DATE 7/18/88 TIME 8.18.33 PAGE 1 AMEF71
OPER CDB

COMPARENT ITEM 100-194-000 CROSS REF ITEM DESCRIPTION PWA DRVR ENGR DRAW 16.001 QTY 1 ITEM TYPE 2 LOW LEVEL 04 UNIT MEAS EA PLANNER 3
STANDARD BATCH QUANTITY 1.000

LLREF CDNBR	COMPONENT CD	& CROSS REF.	DESCRIPTION & COMMENT	ENGINEERING DRAWING NUMBER	QUANTITY PER	ITEM UM	TYP	OPT NO.	FIRST OP SEQ	LT ADJ	EFFECTIVE DATES FROM	TO
05	OP0010.50		OP COST		1.000	EA	4					
05	100-000-003		SCRW PAN PHLP 4-40X.500	40.003	2.000	EA	4					
05	100-007-002		NUT HEX KEP 4-40	40.060	2.000	EA	4					
05	100-024-000		NUT HEX NYLN 6-32	40.131	1.000	EA	4					
05	100-025-000		SCRW PAN SLT NYLN 6-32X1/2	40.132	1.000	EA	4					
05	100-096-001		SKT IC OPEN FRAME 6PIN	24.125	1.000	EA	4					
05	100-096-002		SKT IC OPEN FRAME 14PIN	24.002	2.000	EA	4					
05	100-128-020		CAP MICA 500V 68PF	20.063	2.000	EA	4					
			C24,25									
			CM05FD680J03	CDE								
05	100-149-000		CAP TANT 35V 10UF	20.143	2.000	EA	4					
			C19,21									
			TAPS10M35	ITT								
05	100-150-000		CAP TANT 35V 22UF	20.144	2.000	EA	4					
			C7,9									
			ECSF1VE226K	PANASONIC								
05	100-153-004		CAP DISK 1000V 1000PF	20.004	1.000	EA	4					
			C12									
			DD-102	CENTRALAB								
05	100-153-005		CAP DISK 100V .02UF	20.005	1.000	EA	4					
			C1B									
			TGS 20	SPRAGUE								
05	100-153-006		CAP DISK 100V .05UF	20.006	1.000	EA	4					
			C4									
			TGS 50	SPRAGUE								
05	100-157-000		CAP MONO 100V 1.0UF	20.136	1.000	EA	4					
			C5									
			SR401E105MAA	AVX								
05	100-158-000		CAP MONO 50V 4.7UF	20.137	1.000	EA	4					
			C29									
			5C37Y5U475M050B	SPRAGUE								
05	100-159-000		CAP MONO 50V .33UF	20.138	1.000	EA	4					
			C13									
			5030EM50RD334K	KEYOCERA								
05	100-161-000		CAP MONO 50V 1.0UF	20.041	7.000	EA	4					
			C6,16,17,20,22									
			C26,27									
			2C37Z5U105CB	SPRAGUE								
05	100-163-007		CAP ELECT AX 35V 100UF	20.141	1.000	EA	4					
			C23									
			ECEA 1UU101S	PANASONIC								
05	100-193-001		RES MTL FLM 1% 1/4W 47	21.035	1.000	EA	4					
			R38									
			RN55D 47R5F									
05	100-193-002		RES MTL FLM 1% 1/4W 100 OHMS	21.036	5.000	EA	4					
			R2,22,29,14,15									
			RN55D 1000F									
05	100-193-006		RES MTL FLM 1% 1/4W 261	21.040	1.000	EA	4					
			R44									
			RN55D 2610F									

COMPARENT ITEM 100-194-000 CROSS REF ITEM DESCRIPTION PWA DRVR ENGR DRAW 16.001 QTY 1 ITEM TYPE 2 LOW LEVEL 04 UNIT MEAS EA PLANNER 3

STANDARD BATCH QUANTITY 1.000

LLREF CDNBR	COMPONENT CD	& CROSS REF.	DESCRIPTION & COMMENT	ENGINEERING DRAWING NUMBER	QUANTITY PER	ITEM UM	TYP	OPT NO.	FIRST OP SEQ	LT ADJ	EFFECTIVE DATES FROM	TO
05	100-193-008		RES MTL FLM 1% 1/4W 392 R12 RN55D 3920F	21.042	1.000	EA	4					
05	100-193-013		RES MTL FLM 1% 1/4W 681 R13 RN55D 6810F	21.047	1.000	EA	4					
05	100-193-015		RES MTL FLM 1% 1/4W 1.0K R23,30,31,33 RN55D 1001F	21.049	4.000	EA	4					
05	100-193-018		RES MTL FLM 1% 1/4W 1.5K R16 RN55D 1501F	21.052	1.000	EA	4					
05	100-193-025		RES MTL FLM 1% 1/4W 3.01K R17,42 RN55D 3011F	21.059	2.000	EA	4					
05	100-193-032		RES MTL FLM 1% 1/4W 4.75K R28 RN55D 4751F	21.066	1.000	EA	4					
05	100-193-050		RES MTL FLM 1% 1/4W 9.53K R36 RN55D 9531F	21.081	1.000	EA	4					
05	100-193-051		RES MTL FLM 1% 1/4W 10.0K R9,10,35 RN55D 1002F	21.082	3.000	EA	4					
05	100-193-053		RES MTL FLM 1% 1/4W 12.1K R8,32 RN55D 1212F	21.084	2.000	EA	4					
05	100-193-055		RES MTL FLM 1% 1/4W 15.0K R26 RN55D 1502F	21.086	1.000	EA	4					
05	100-193-060		RES MTL FLM 1% 1/4W 20.0K R19,20 RN55D 2002F	21.091	2.000	EA	4					
05	100-193-066		RES MTL FLM 1% 1/4W 30.1K R24,25,47,48 RN55D 3012F	21.097	4.000	EA	4					
05	100-193-092		RES MTL FLM 1% 1/4W 100K R40,41,46 RN55D 1003F	21.125	3.000	EA	4					
05	100-193-098		RES MTL FLM 1% 1/4W 205K R34,37 RN55D 2053F	21.131	2.000	EA	4					
05	100-193-105		RES MTL FLM 1% 1/4W 499K R39 RN55D 4993F	21.140	1.000	EA	4					
05	100-193-110		RES MTL FLM 1% 1/4W 806K R18; R21 RN55D 8063F	21.148	2.000	EA	4					

COMPARENT ITEM 100-194-000 CROSS REF ITEM DESCRIPTION PWA DRVR ENGR DRAW 16.001 QTY 1 ITEM TYPE 2 LOW LEVEL 04 UNIT MEAS EA PLANNER 3

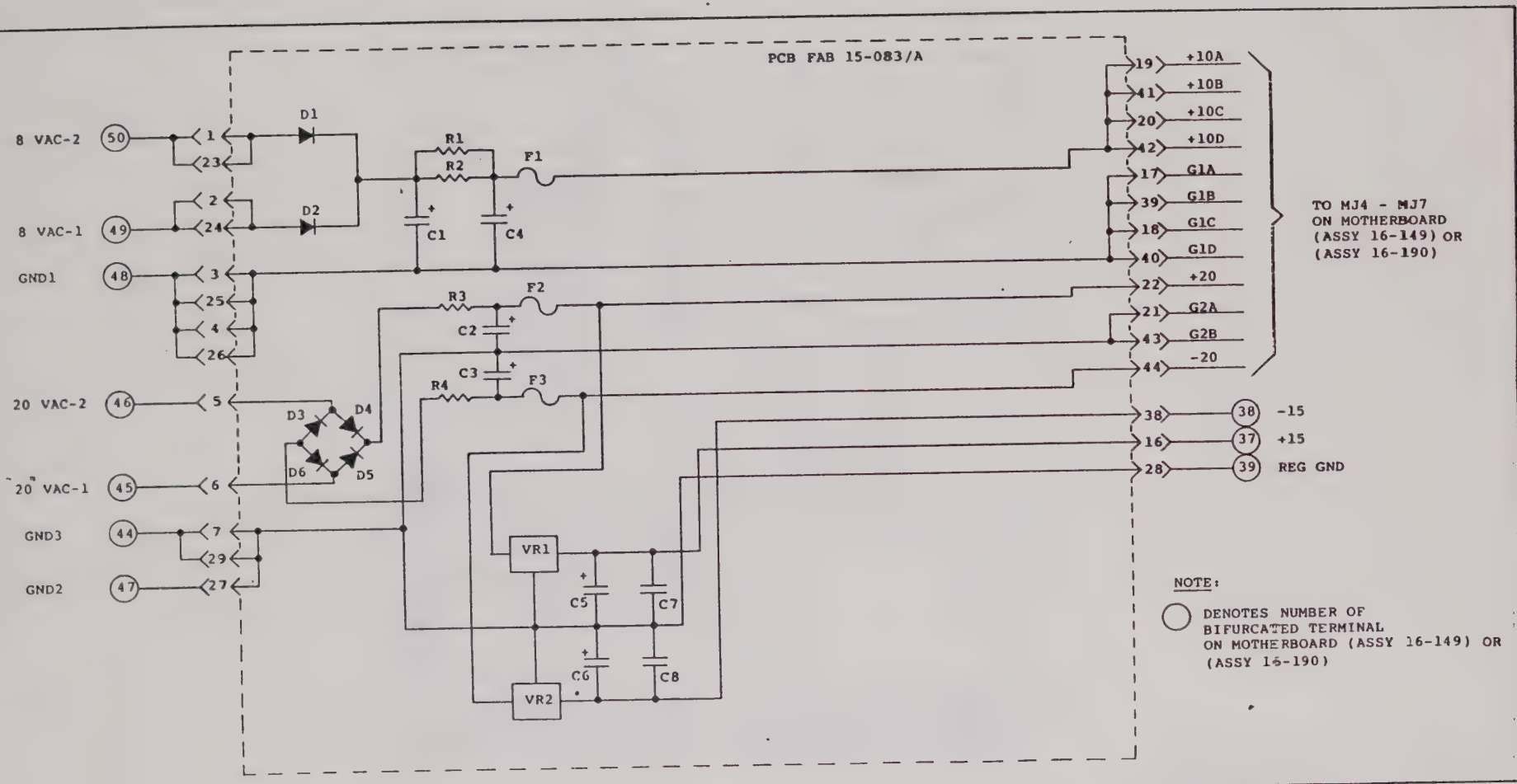
STANDARD BATCH QUANTITY 1.000

LLREF CDNBR	COMPONENT CD	CROSS REF.	& DESCRIPTION & COMMENT	ENGINEERING DRAWING NUMBER	QUANTITY PER	ITEM UM	TYP	OPT NO.	FIRST OP SEQ	LT ADJ	EFFECTIVE DATES FROM	TO
05	100-194-CMP		COMP LAYOUT DRIVER	B-2030	.000	EA	9					
05	100-194-REV		BOM REVISION LEVEL C		.000	EA	9					
05	100-194-SCH		SCHEMATIC DRWG DRIVER	B-1274	.000	EA	9					
05	100-588-007		RES WW 3W 1.0K	21.254	1.000	EA	4					
			R27									
			RW69 V1B2	DALE								
05	100-589-004		RES WW 5W 1K	21.246	1.000	EA	4					
			R45									
			RW67 V1B2	DALE								
05	100-590-001		RES WW 10W 25Ω	21.014	1.000	EA	4					
			R11									
			RW68 V251	DALE								
05	100-655-000		PWB DRVR	15.127	1.000	EA	4					
05	100-792-000		SPACER CL #4 .187"	31.025	2.000	EA	4					
05	100-828-001		POT TRIM 10T HORZ 10K	21.261	1.000	EA	4					
			R6									
			3006P-1-103	BOURNS								
05	100-828-002		POT TRIM 20T HORZ 500	21.238	1.000	EA	4					
			R3									
			B9PR500	BECKMAN								
05	100-828-004		POT TRIM 20T HORZ 5.0K	21.239	2.000	EA	4					
			R1,4									
			3006P-1-502	BOURNS								
05	100-828-007		POT TRIM 20T HORZ 500K	21.271	2.000	EA	4					
			R5,7									
			3006P-1-504	BOURNS								
05	100-844-000		SPACER NYLN CL #6 1/4"	31.152	1.000	EA	4					
05	101-286-009		HEDR PCMNT .1" 1ROW 36CONT PIN	24.071	.330	EA	4					
			12EA 1 CONT									
05	101-368-000		DIODE 1N914 100V 20MA	19.001	10.000	EA	4					
			CR2,3,5,6,8,10-13,17									
			1N914B	ITT								
05	101-370-000		DIODE 1N4004 400V 1A	19.003	1.000	EA	4					
			CR14									
			1N4004	MOTOROLA								
05	101-376-000		IC CLM60 PHOTO-RESISTOR	19.009	1.000	EA	4					
			U1									
			CLM 60	CLAIREX								
05	101-383-000		IC TL084 QUAD OPAMP	19.016	2.000	EA	4					
			U2,3									
			TL084BCN	TI								
05	101-395-000		XSTR 2N5308 NPN DARL 40V 2MA	19.028	1.000	EA	4					
			Q3									
			2N5308	GENERAL ELECTRIC								
05	101-398-000		FET VN88A N MOS 15W 80V 1A	19.031	2.000	EA	4					
			Q1,2 (VALUE MAY VARY WITH APPLICATION)									
			VN88AF	SILICONIX								
05	101-410-000		DIODE 1N5244A ZENER .5W 14V	19.043	2.000	EA	4					
			CR15,16									
			1N5244A	MOTOROLA								

COMPARENT ITEM 100-194-000 CROSS REF ITEM DESCRIPTION PWA DRVR
ENGR DRAW 16.001
STANDARD BATCH QUANTITY 1.000

QTY 1 ITEM TYPE 2 LOW LEVEL 04
UNIT MEAS EA PLANNER 3

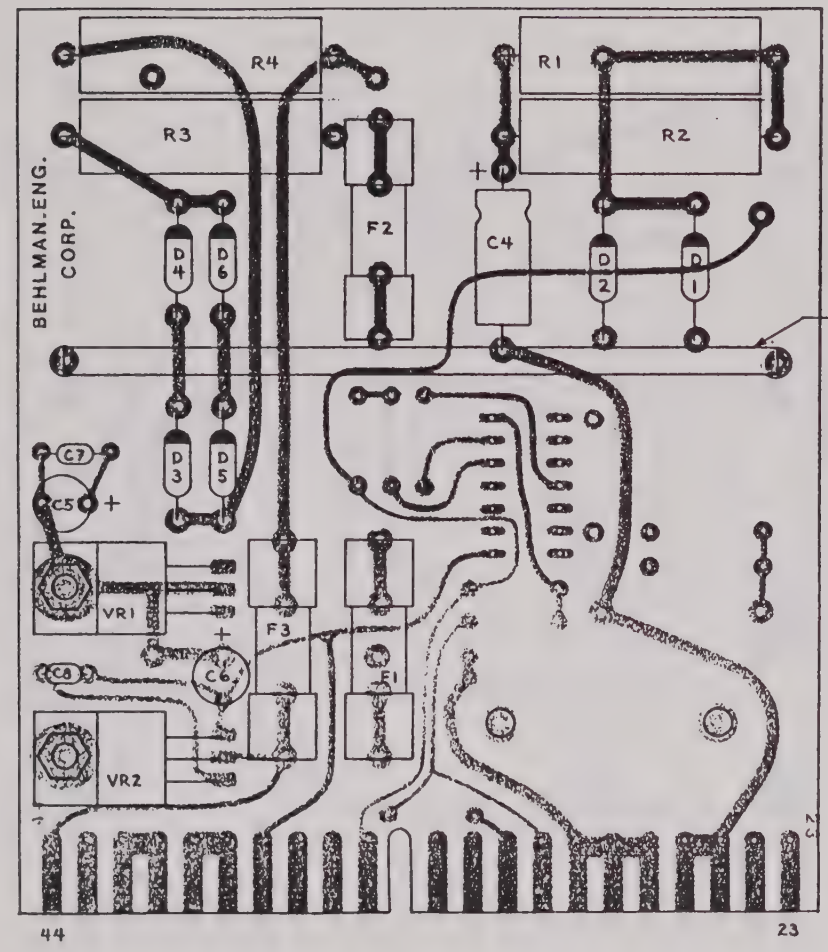
LLREF CDNBR	COMPONENT CD & CROSS REF.	DESCRIPTION & COMMENT	ENGINEERING DRAWING NUMBER	QUANTITY PER	ITEM UM	TYP	OPT NO.	FIRST OP SEQ	LT ADJ	EFFECTIVE DATES FROM	TO
05	101-423-000	DIAC 1N5762A 36V .1A Q4 IN 5762A	19.058 MOTOROLA	1.000	EA	4					
05	101-509-000	IC 78L15 VREG +15V .1A VR1 MC78L15CT	19.144 MOTOROLA	1.000	EA	4					
05	101-510-000	IC 79L15 VREG -15VDC .1A VR2 MC79L15CT	19.145 MOTOROLA	1.000	EA	4					
05	101-518-000	DIODE 1N4761A ZENER 1W 75V CR7 IN 4761A	19.153 MOTOROLA	1.000	EA	4					
05	101-554-000	XSTR TIP31C NPN 40W 100V 3A Q5,6 TIP 31C	19.197 TI	2.000	EA	4					
05	101-556-000	DIODE 1N4748A ZENER 1W 22V CR9 IN4748A	19.199 MOTOROLA	1.000	EA	4					
05	101-611-000	WIRE BUSS 22AWG C1,8 BEHLMAN	30.019	2.000	FT	4					
05	102-420-000	RES MTL FLM .1% 1/4W 10K R43,49,50,51 RNC55H 1002BS	21.291	4.000	EA	4					



BEHLMAN

DRAWN BY WTE		APPROVALS: ENGRG: Q.A.	
DATE 1-5-84			
TITLE SCHEMATIC - POWER SUPPLY, UNREG.			
ASSY NO. 16-193 100-392-SCH	SIZE B	DRAWING NO. 2062	REV A
		SHEET 1 OF 1	

NEXT ASSY	USED ON
APPLICATION	

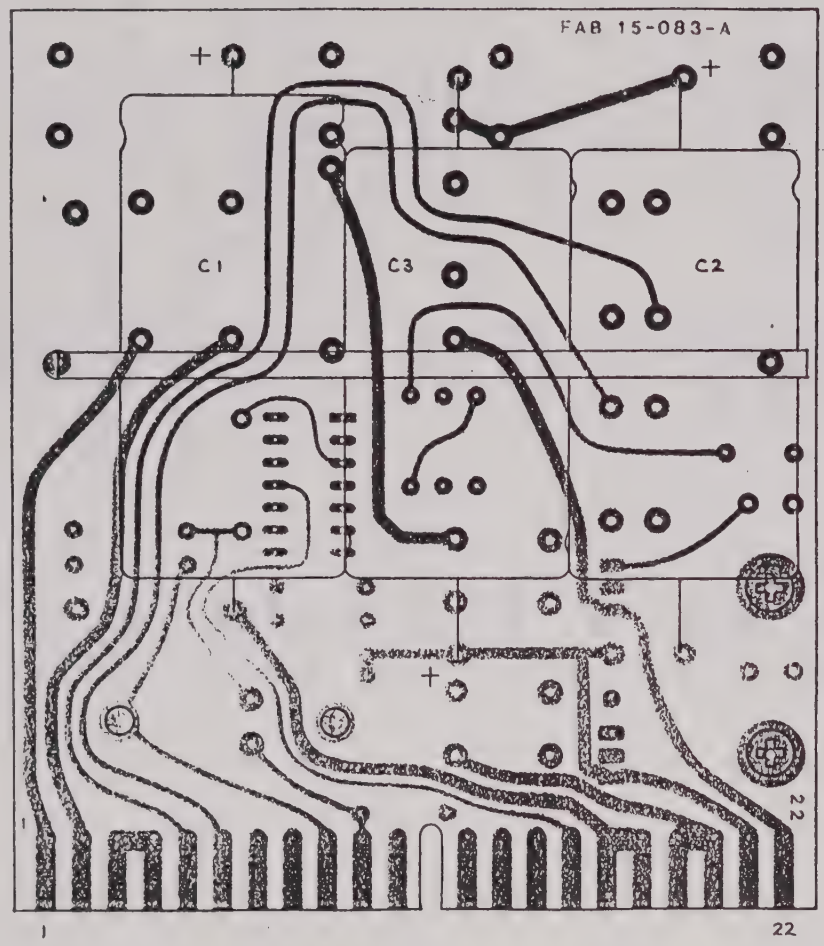


16-149 OR 16-190	
NEXT ASSY	USED ON
APPLICATION	

BEHLMAN — 1748 MARK AVENUE - CARPINTERIA, CA 93013

DRAWN BY PLK	APPROVALS: ENGRG: Jay L Kill
DATE 1-5-84	Q.A.
TITLE COMPONENT LAYOUT - PWR SUP., UNREG.	
ASSY NO. 16-193 100-396-CMA	SIZE B
DRAWING NO. 2063	REV A
SHEET 1 OF 2	

SCARAB GRAPHICS NO. 83748



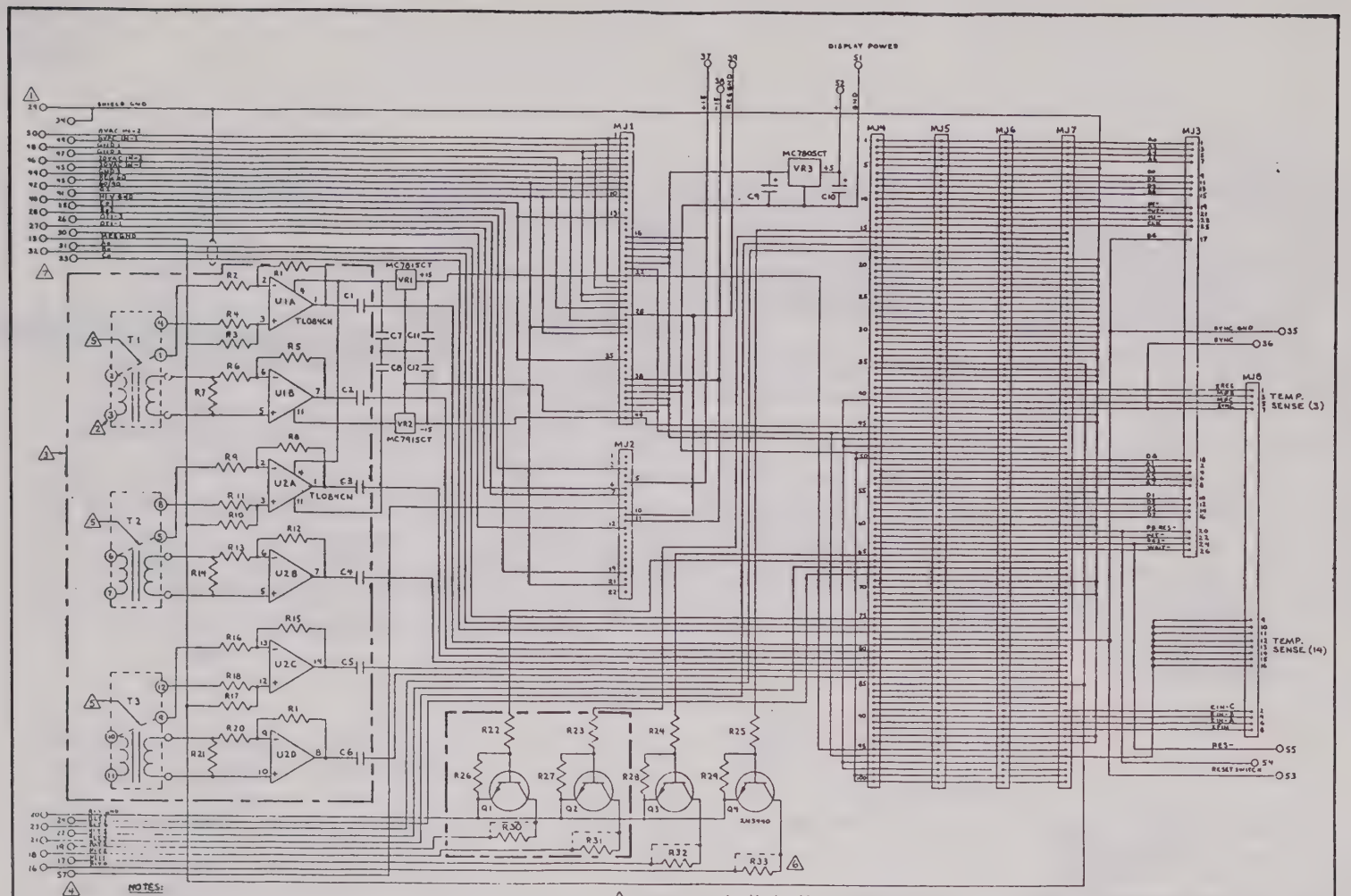
BEHLMAN	1148 MARK AVENUE · CARPINTERIA, CA 93013	
DRAWN BY PLK		APPROVALS: ENGRG: Jay L Killin
DATE 1-5-84		Q.A.
TITLE COMPONENT LAYOUT - PWR SUP., UNREG.		
ASSY NO. 16-193 100-396-CMB	SIZE B	DRAWING NO. 2063 REV A
		SHEET 2 OF 2

16-149 OR 16-190	
NEXT ASSY	USED ON
APPLICATION	

SCARAB GRAPHICS NO. 83746

COMPARENT ITEM 100-396-000 CROSS REF ITEM DESCRIPTION PWA KB DC SUPLY UNRGLTD ENGR DRAW 16.193 STANDARD BATCH QUANTITY 1.000 QTY 1 ITEM TYPE 2 UNIT MEAS EA LOW LEVEL 03 PLANNER 3

LLREF CDNBR	COMPONENT CD	CROSS REF.	& DESCRIPTION & COMMENT	ENGINEERING DRAWING NUMBER	QUANTITY PER	ITEM UM	TYP	OPT NO.	FIRST OP SEQ	LT ADJ	EFFECTIVE DATES FROM	TO
04	OP0004.10		OP COST		1.000	EA	4					
04	100-055-000		FUSE 32V 1.5A F2,3 30301.5	37.015 LITTELFUSE	2.000	EA	4					
04	100-056-000		FUSE 32V 4A F1 303004	37.016 LITTELFUSE	1.000	EA	4					
04	100-057-000		HLDR FUSE PCB 102080	37.017 LITTELFUSE	6.000	EA	4					
04	100-093-001		CAP ELECT RAD 25V 25UF C4 TVA-1205	20.042 SPRAGUE	1.000	EA	4					
05	100-147-000		CAP TANT 25V 10UF C5,6 199D106X0025CAT	20.133 SPRAGUE	2.000	EA	4					
05	100-154-000		CAP MONO 50V .10UF C7,8 SR205E104MAA	20.007 AVX	2.000	EA	4					
04	100-163-010		CAP, ELECT AX 35V 220UF C2,3	20.182	2.000	EA	4					
04	100-163-011		CAP, ELECT AX 25V 4700UF C1	20.183	1.000	EA	4					
04	100-396-CMP		COMPONENT LAYOUT - DC SUP UNRE	B-2063-A	.000	EA	9					
04	100-396-REV		BOM REVISION LEVEL B		.000	EA	9					
04	100-396-SCH		SCHEMATIC - 100-392-SCH	B-2062-A	.000	EA	9					
04	100-588-002		RES WW 3W 1.0 R1,2 (VALUE MAY VARY WITH APPLICATION) RW69V1R0	21.009 DALE	2.000	EA	4					
04	100-589-005		RES WW 5W 5.0 R3,4 (VALUE MAY VARY WITH APPLICATION) RW67V5R0	21.249 DALE	2.000	EA	4					
04	100-643-000		PWB KB DC PWR SUPLY-RGLTD 15-083/A	15.083 BEHLMAN	1.000	EA	4					
04	100-916-000		TIE CABLE 4"	33.002	3.000	EA	4					
04	100-974-000		FOAM GRY 15.25X9X.25	35.017	1.000	EA	4					
05	101-370-000		DIODE 1A 400V 1N4004 D3-6 1N4004	19.003 MOTOROLA	4.000	EA	4					
05	101-401-000		IC VREG 1.5A +15VDC VR1 MC7815CT	19.034 MOTOROLA	1.000	EA	4					
05	101-402-000		IC VREG 1.5A -15VDC VR2 MC7915CT	19.035 MOTOROLA	1.000	EA	4					
04	101-413-000		DIODE REC 6A 100V D1,2 60S1	19.046 IR	2.000	EA	4					



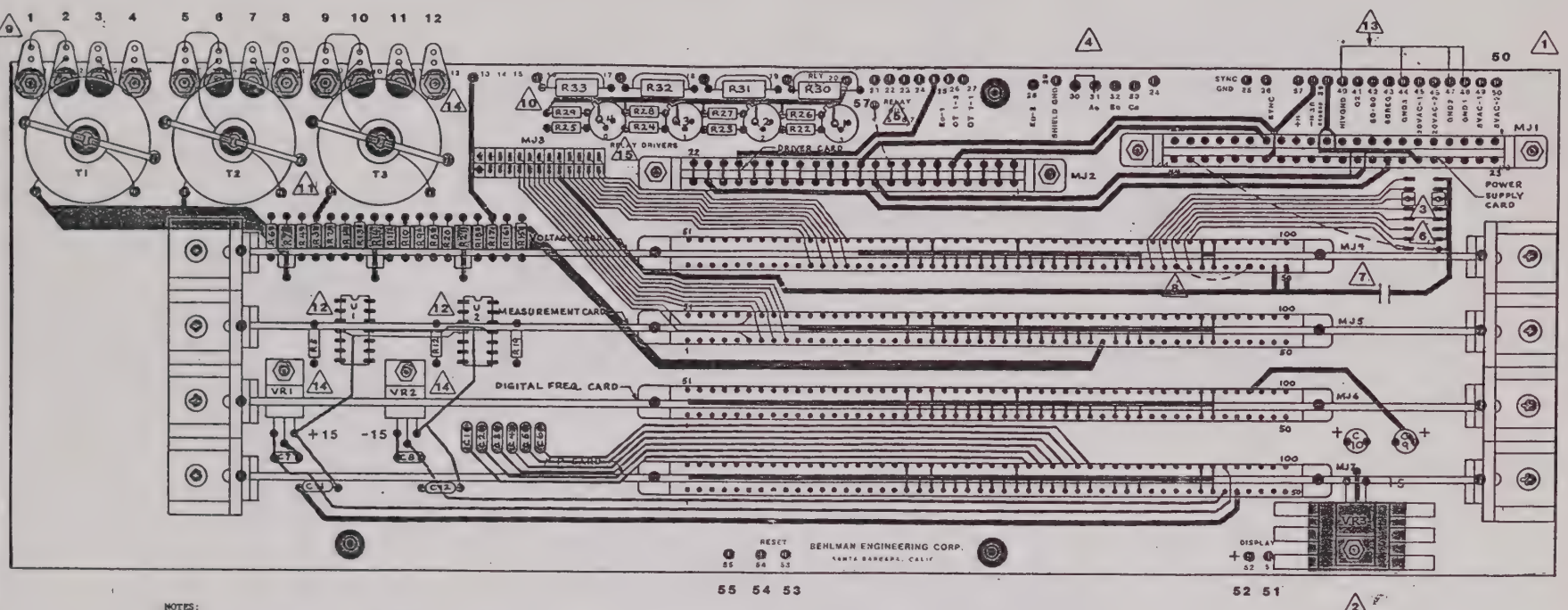
NOTES:

1. BIFURCATED TERMINALS (TYP).
2. SOLDER LUG NUMBER (TYP).
3. T1 THROUGH T3 ARE NOT REQUIRED WHEN 1,2 AND 3 PHASE UNITS HAVE OPTION 361 OR 362.
4. POSITIVE FEEDBACK REQUIRED FOR KB "B" AND "D" MODELS.
5. JUMPERS REMOVED WHEN OPTION 375 OR 361 IS REQUIRED.
6. JUMPERS REMOVED FROM R30 THROUGH R33 UNLESS OPTIONS 361, 362, OR 375 ARE REQUIRED.
7. GROUND INPUTS 40, 44, 47, 48 ARE JUMPERED TOGETHER.

BEHLMAN
A Fiskars Company
1142 Mark Avenue • Carpinteria, CA 93013

DRAWN BY: PLK	APPROVALS:	
DATE: 5-2-86	ENGRG:	
	Q.A.:	
TITLE: 1, 2, or 3 PHASE MOTHERBOARD		
ASSY NO.: 16-149	SIZE: B	DRAWING NO.: C-1004
REV: B	SHEET: 1 OF 1	

THIS DRAWING CONTAINS PROPRIETARY INFORMATION OF BEHLMAN ENGINEERING AND MAY NOT, IN WHOLE OR IN PART, BE DUPLICATED OR DISCLOSED OR USED FOR MANUFACTURE OF ANY PART DISCLOSED HEREIN WITHOUT THE PRIOR WRITTEN PERMISSION OF BEHLMAN.



NOTES:

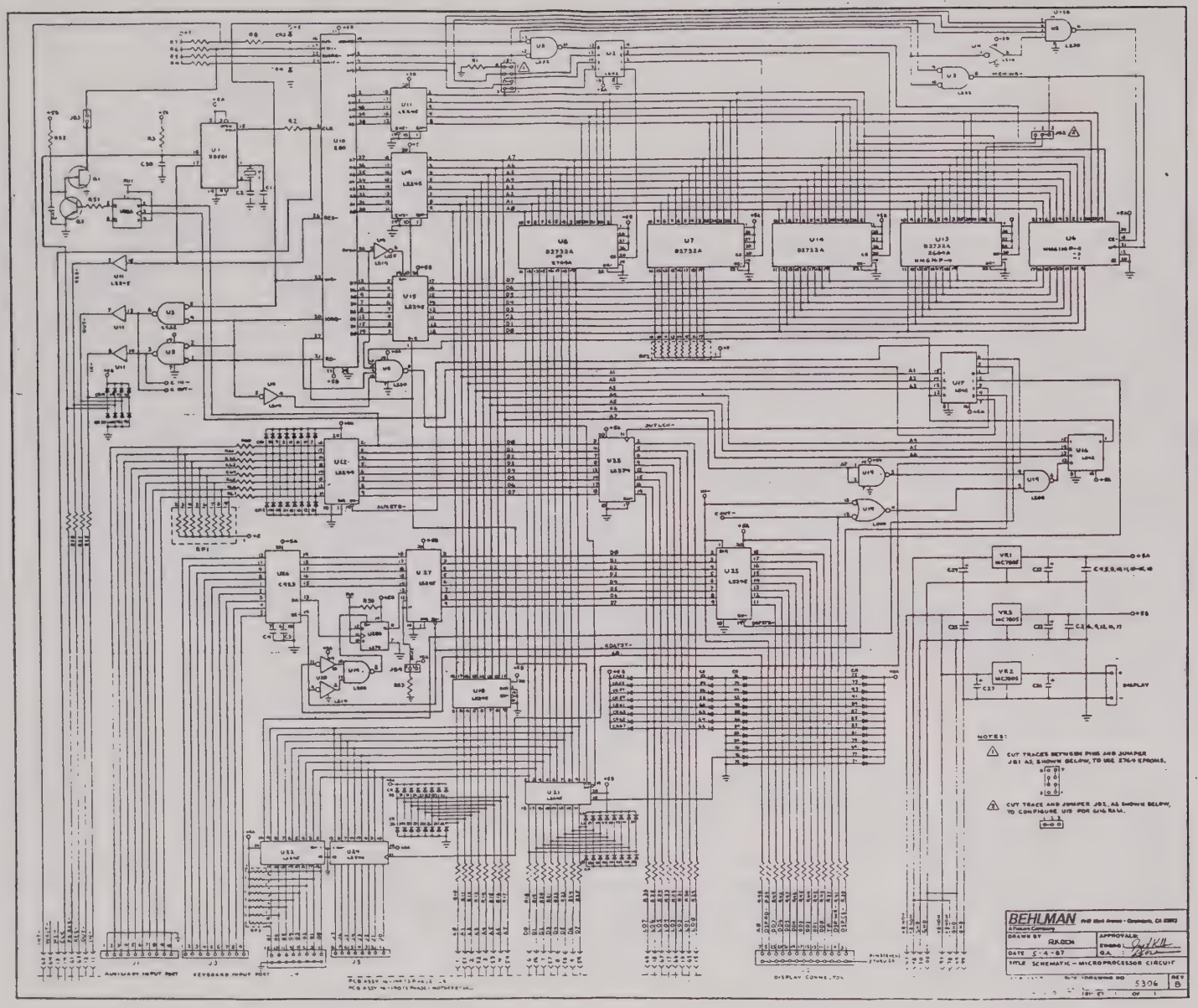
1. BIFURCATED TERMINALS (48 PLACES)-PRESS FIT WITH SLOTS 90° TO PCB EDGE.
2. INSTALL 6070B HEAT SINKS WITH THERMALCOTE #251 THERMAL JOINT COMPOUND OR EQUIVALENT. USE 6-32 X .375 SCREW INSTALLED FROM CIRCUIT SIDE WITH SPLIT WASHER AND SMALL PATTERN NUT.
3. INSTALL SINGLE CONTACT MALE HEADERS.
4. JUMPER (22 AWG BUSS) TERMINALS 30 TO 31.
5. INSTALL TERMINAL 57 AND JUMPER (22 AWG BUSS) TEFLON SLEEVED FROM TERMINAL 57 TO MJ2-9.
6. JUMPER (22 AWG BUSS) TEFLON SLEEVED FROM MJ1-43 TO MJ8-9 CIRCUIT SIDE.
7. CUT AND REMOVE TRACE-APPROXIMATELY 1/8" SECTION.
8. JUMPER (22 AWG BUSS) TEFLON SLEEVED FROM MJ4-41 TO MJ4-47 CIRCUIT SIDE.
9. JUMPER 1 & 2, 5 & 6, 9 & 10 WITH (22 AWG BUSS) WIRE. REMOVE JUMPERS WHEN OPTION 361, 362, OR 375 IS REQUIRED.
10. RAISE RESISTOR 1/2 DIAMETER FROM BOARD. JUMPER (22 AWG BUSS) TEFLON SLEEVED ACROSS R30, R31, R32, R33. REMOVE JUMPERS FROM R30, THROUGH R33 UNLESS OPTION 375, 361, OR 362 IS REQUIRED.
11. T1 THROUGH T3 ARE NOT REQUIRED WHEN 1, 2, AND 3 PHASE UNITS HAVE OPTION 361, 362, OR UNITS WITH PHASE CURRENTS OVER 40 AMPS.
12. SOCKETS REQUIRED.
13. JUMPER (22 AWG BUSS TEFLON SLEEVED) TERMINALS 40, 44, 47, 48 CIRCUIT SIDE OF BOARD.
14. USE 6-32 X .250 SCREWS INSTALLED FROM CIRCUIT SIDE WITH SPLIT WASHER AND SMALL PATTERN NUT (14 PLACES).
15. INSTALL TRANSISTOR PADS UNDER Q1-4 WITH KNOBS UP.

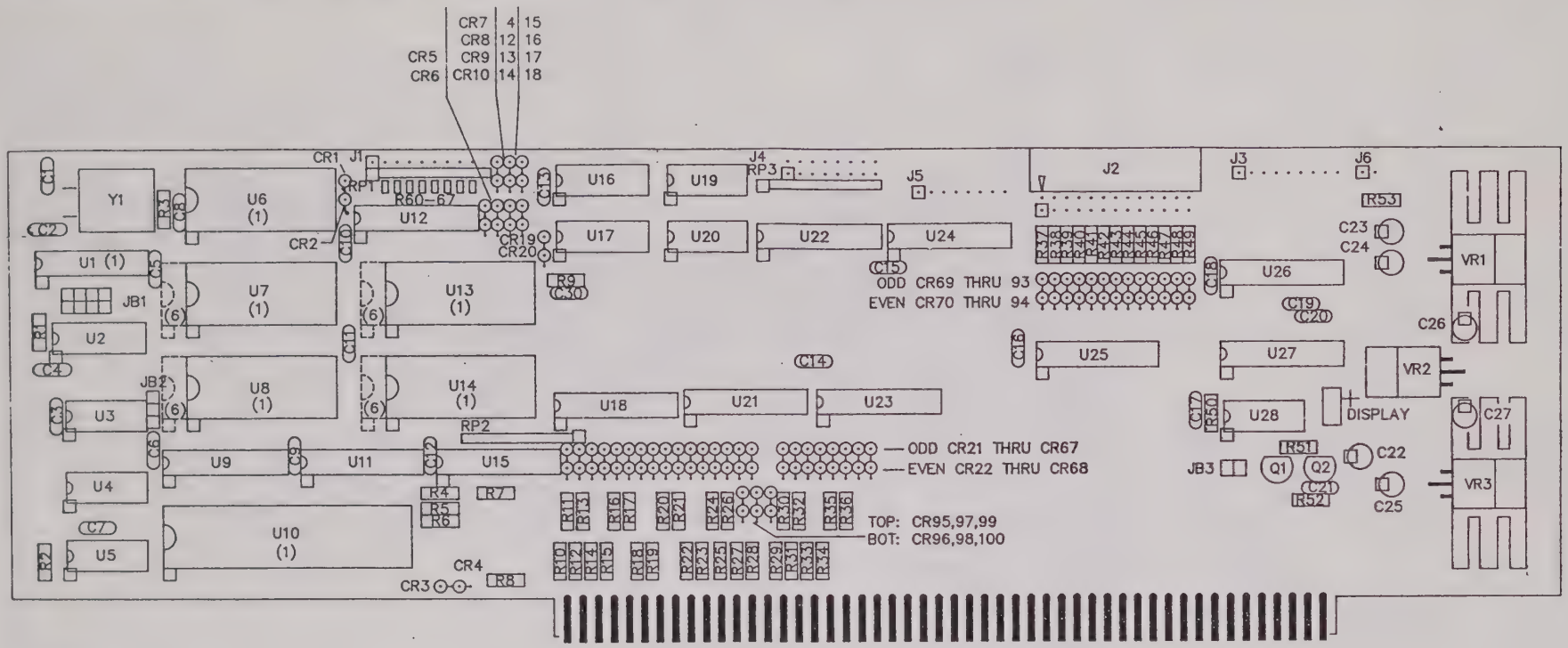
BOTTOMPLATE	
NEXT ASSY	USED ON
APPLICATION	

BEHLMAN A Fiskars Company — 1142 Mark Avenue • Carpinteria, CA 93013

DRAWN BY: P.L. KOCH	APPROVALS: ENGRG: Jay L. Kellen
DATE: 3-16-88	Q.A. : Tom Shepard
TITLE: COMPONENT LAYOUT 1, 2, OR 3 PHASE MOTHERBOARD	
ASSY NO. 16-149	SIZE B
DRAWING NO. 1889	REV E
SHEET 1 OF 1	

SCARAB GRAPHICS NO. 83746


NOTES:
1. CUT TRACES BETWEEN PINS AND JUMPER J81 AS SHOWN BELOW, TO USE 2764 EPROMS.
2. CUT TRACE AND JUMPER J82, AS SHOWN BELOW, TO CONFIGURE U15 FOR 6116 RAM.
BEHLMAN
A Polaron Company
DRAWN BY R.R.OLSEN
APPROVALS
ENGRG
Q.A.
DATE 5-4-87
TITLE SCHEMATIC - MICROPROCESSOR CIRCUIT
DWG NO 5306
REV B
SHT 1 OF 1



NOTES:

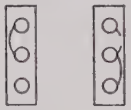
(1) INSTALL SOCKET, 7 PLACES

2. JUMPER BLOCK 1 (JB1):
CONFIGURATION OF U7,8,13,14

2732
(DEFAULT)

2764
CUT TRACES, 3 PLACES,
CIRCUIT SIDE

3. JUMPER BLOCK 2 (JB2):



U13
6116
(DEFAULT)

U13
2732
OR
2764

CUT TRACE
CIRCUIT SIDE

4. JUMPER BLOCK 3 (JB3):

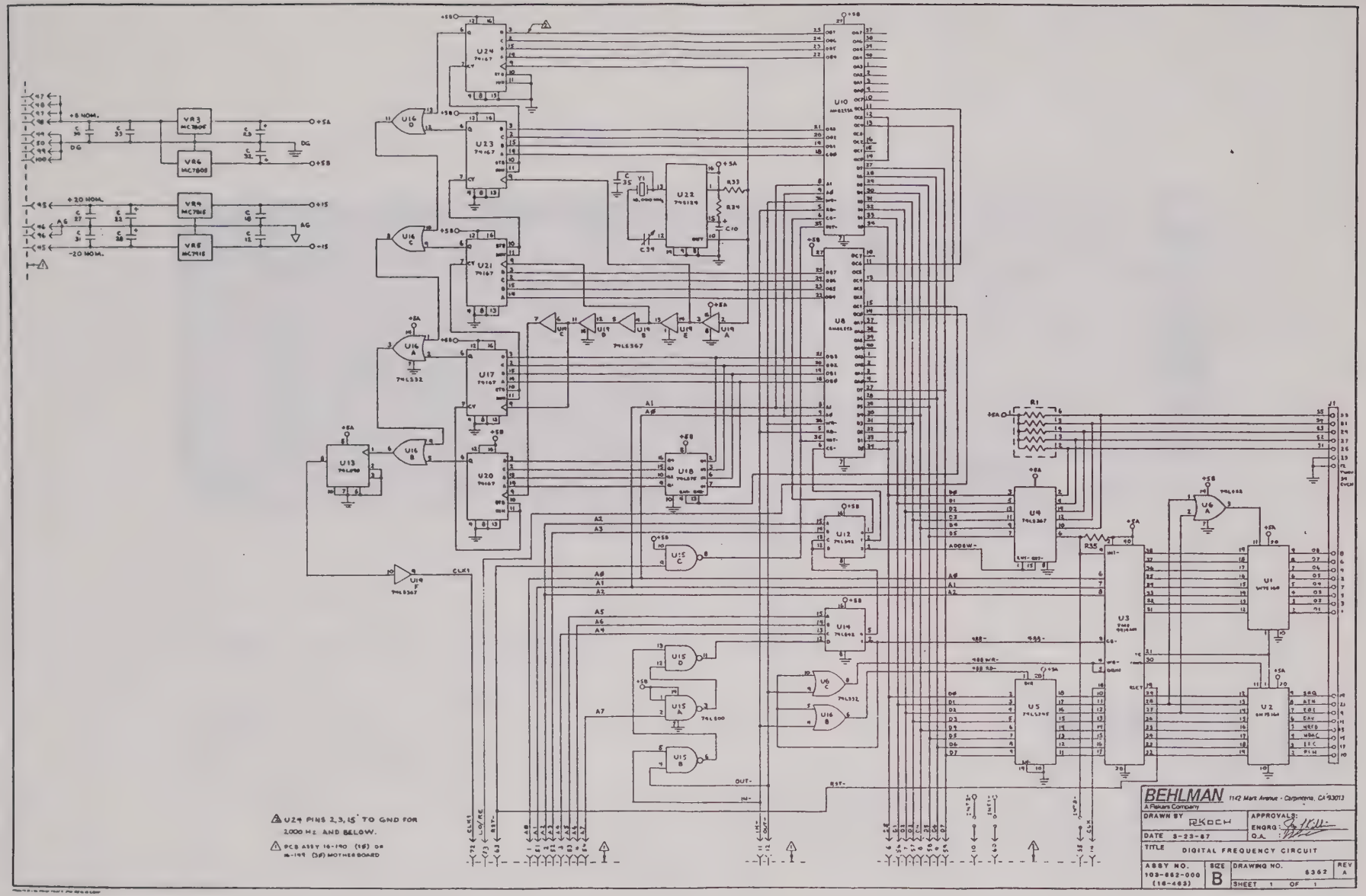
SHORT TO ACTIVATE
NMI TIMER.

5. ALL CR INSTALLED STANDING UP
CATHODE (STRIPE) SIDE ON MARKED HOLE.

EG.:

(6.) INSERT 28-PIN SOCKET FOR I.C. 2764 WITH PIN 1 IN THIS POSITION ONLY. WHEN USING I.C. 2732, INSERT 24-PIN SOCKET IN ALTERNATE POSITION AS SHOWN, NOTE (1)

BEHLMAN 1142 MARK AVENUE - CARPINTERIA, CA 93013			
DRAWN BY PLK		APPROVALS: ENGRG:	
DATE 5-4-87		Q.A.	
TITLE COMPONENT LAYOUT—MICROPROCESSOR CARD			
PART NO. 100-343-000 (16-141)	SIZE B	DRAWING NO. 5307	REV B
		SHEET 1 OF	



⚠ U24 PINS 2,3,15 TO GND FOR 2,000 Hz AND BELOW.

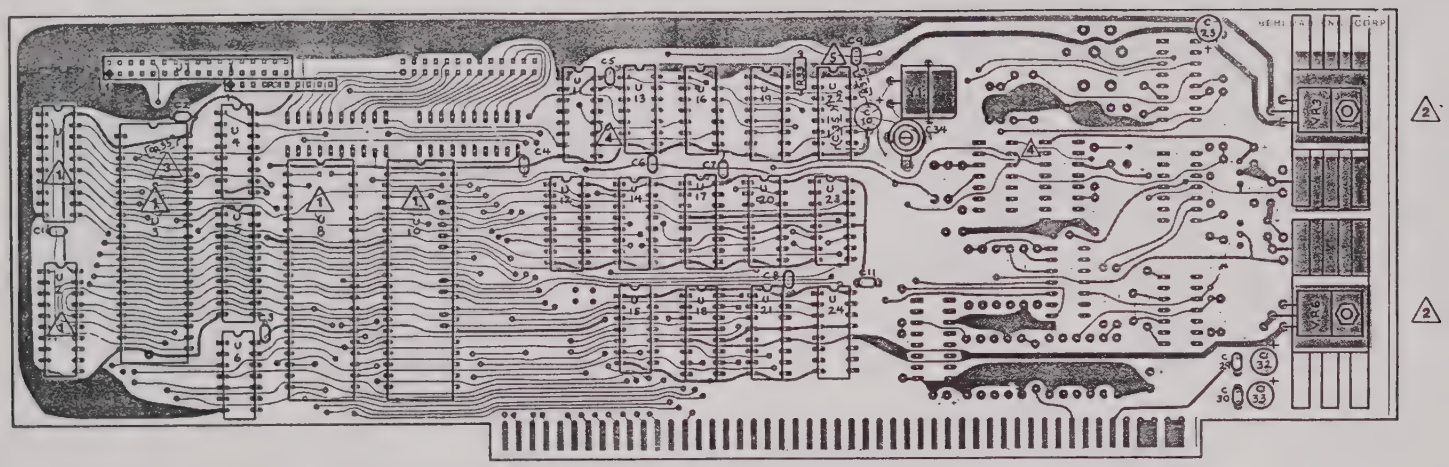
⚠ PCB ASSY 16-190 (1/2) OR 16-199 (3/4) MOTHERBOARD

BEHLMAN 1142 Mark Avenue - Carpinteria, CA 93013
A Fluke Company

DRAWN BY	RKOCH
DATE	3-23-87
APPROVALS: ENGRG:	
Q.A.	

TITLE DIGITAL FREQUENCY CIRCUIT

ASSY NO.	SIZE	DRAWING NO.	REV
103-862-000 (16-463)	B	6362	A
		SHEET 1 OF 1	



NOTES:

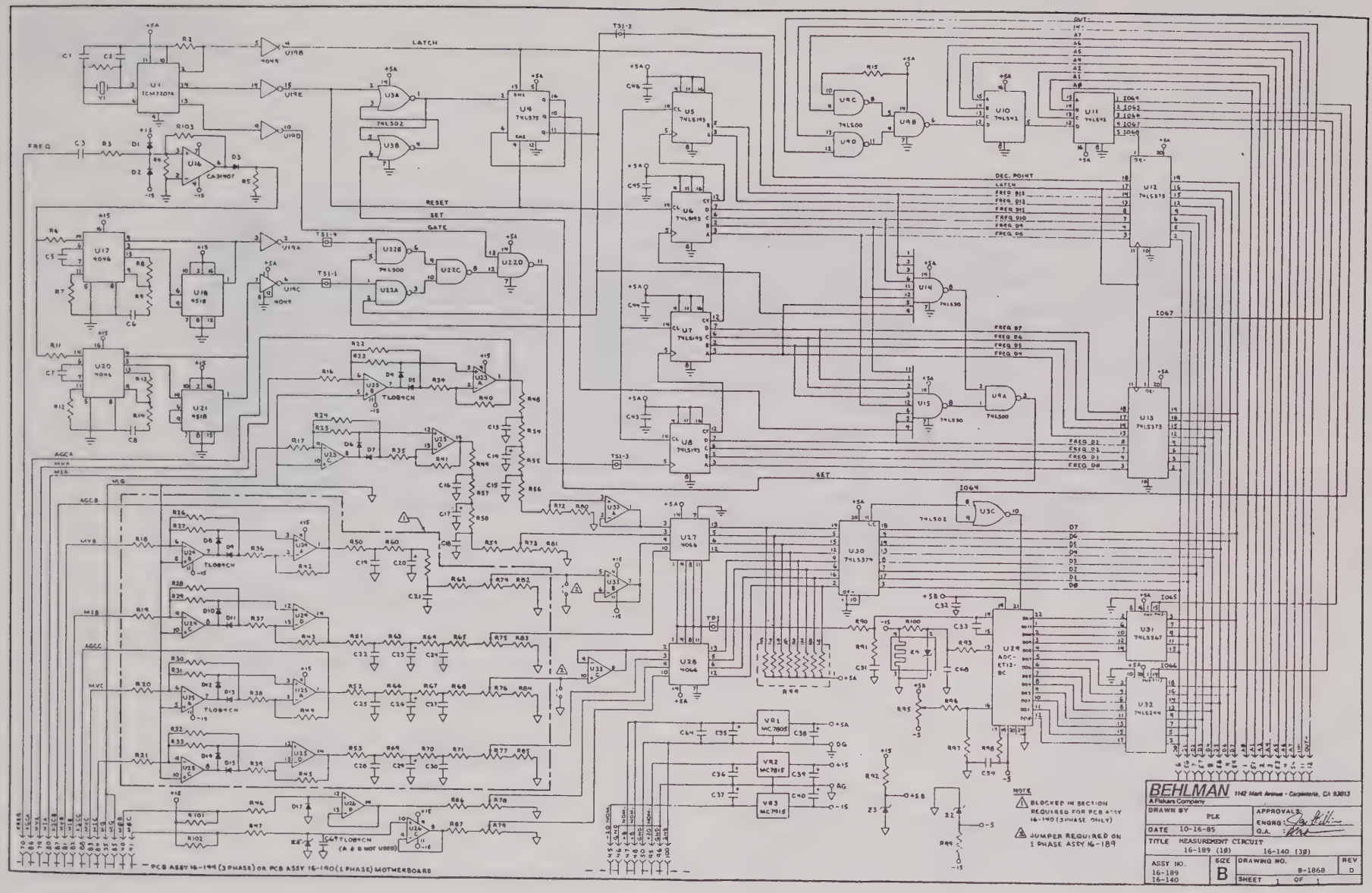
1. SOCKETS REQUIRED.
2. INSTALL 6070B HEAT SINK WITH THERMALCOTE #251 THERMAL JOINT COMPOUND OR EQUIVALENT.
3. MOUNT R35 ON CIRCUIT SIDE OF BOARD. BETWEEN U3-40 AND U4-6 (U3-9).
4. INSTALL JUMPER AS SHOWN.
5. CUT TRACE BETWEEN U22-15 AND U22-16 ON CIRCUIT SIDE

16-149 OR 16-150	
NEXT ASSY	USED ON
APPLICATION	

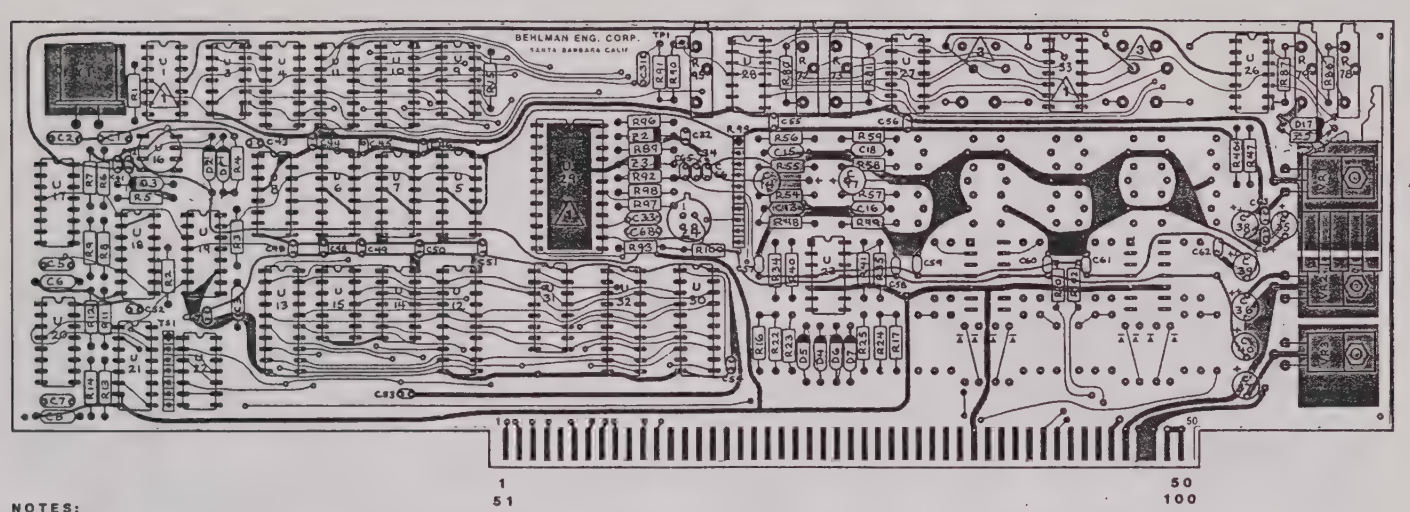
BEHLMAN 1142 Mark Avenue • Carpinteria, CA 93013
A Fiskars Company

DRAWN BY	SEV	APPROVALS: ENGRG:	
DATE	2-10-88	Q.A. :	
TITLE	COMPONENT LAYOUT- DIGITAL FREQUENCY CARD		
ASSY NO. 103-652-000 (16-463)	SIZE B	DRAWING NO. 5368	REV D
		SHEET 1 OF 1	

SCARAB GRAPHICS NO 83746


LATCH
RESET
SET
GATE
FREQ
AGCA
AGCB
AGCC
MVA
MVB
MVC
MEA
MEB
MEC
DEC. POINT
LATCH
FREQ D12
FREQ D11
FREQ D10
FREQ D9
FREQ D8
FREQ D7
FREQ D6
FREQ D5
FREQ D4
FREQ D3
FREQ D2
FREQ D1
FREQ D0
I067
I064
I065
I066
I063
I062
I061
I060
OUT
U1 ICM7207A
U2 74LS02
U3 74LS00
U4 74LS75
U5 74LS193
U6 74LS193
U7 74LS193
U8 74LS193
U9 74LS00
U10 74LS42
U11 74LS42
U12 74LS378
U13 74LS373
U14 74LS30
U15 74LS30
U16 CA3140T
U17 4046
U18 4518
U19 4049
U20 4046
U21 4518
U22 74LS00
U23 TL084CN
U24 TL084CN
U25 TL084CN
U26 TL084CN
U27 4066
U28 4066
U29 ADC-ET12-BC
U30 74LS374
U31 74LS367
U32 74LS244
U33 74LS02
VR1 MC7805
VR2 MC7815
VR3 MC7915
T31-1
T31-2
T31-3
T31-4
TP1
+5A
+15
-15
+5B
DG
AG
NOTE
BLOCKED IN SECTION REQUIRED FOR PCB ASSY 16-140 (3PHASE ONLY)
JUMPER REQUIRED ON 1 PHASE ASSY 16-189
PCB ASSY 16-189 (3 PHASE) OR PCB ASSY 16-190 (1 PHASE) MOTHERBOARD
BEHLMAN
A Fisher Company
1142 Mark Avenue - Carpinteria, CA 93013
DRAWN BY PLK
DATE 10-16-85
APPROVALS
ENGRG:
Q.A.:
TITLE MEASUREMENT CIRCUIT
16-189 (1Ø) 16-140 (3Ø)
ASSY NO. 16-189 16-140
SIZE B
DRAWING NO. B-1868
REV D
SHEET 1 OF 1

THIS DRAWING CONTAINS PROPRIETARY INFORMATION OF BEHLMAN ENGINEERING AND MAY NOT, IN WHOLE OR IN PART, BE DUPLICATED OR DISCLOSED OR USED FOR MANUFACTURE OF ANY PART DISCLOSED HEREIN WITHOUT THE PRIOR WRITTEN PERMISSION OF BEHLMAN.



NOTES:

1. SOCKETS REQUIRED.
2. INSTALL 60708 HEAT SINK WITH THERMALCOTE #251 THERMAL JOINT COMPOUND OR EQUIVALENT.
3. INSTALL JUMPER, NO. 26 AWG, TEFLON-SLEEVED.
4. R103 INSTALLED ON BACK SIDE BETWEEN D1 AND D3 AS SHOWN. C69 INSTALLED ON BACK SIDE IN PARALLEL WITH Z5. (SEE PG. 2)

16-201	B-2197
16-190	B-2051
NEXT ASSY	REF. DWG
APPLICATION	

BEHLMAN A Fiskars Company — 1142 Mark Avenue • Carpinteria, CA 93013

DRAWN BY: PLK/SEV	APPROVALS: ENGRG: Jay L Killip
DATE: 6-29-88	Q.A.: John Hugard
TITLE: COMPONENT LAYOUT-PWA, MEAS. CARD, 10	
PART NO. 100-392-CMP (16-189)	SIZE B
DRAWING NO. 2050	REV E
SHEET 1 OF 2	

SCARAB GRAPHICS NO 83746

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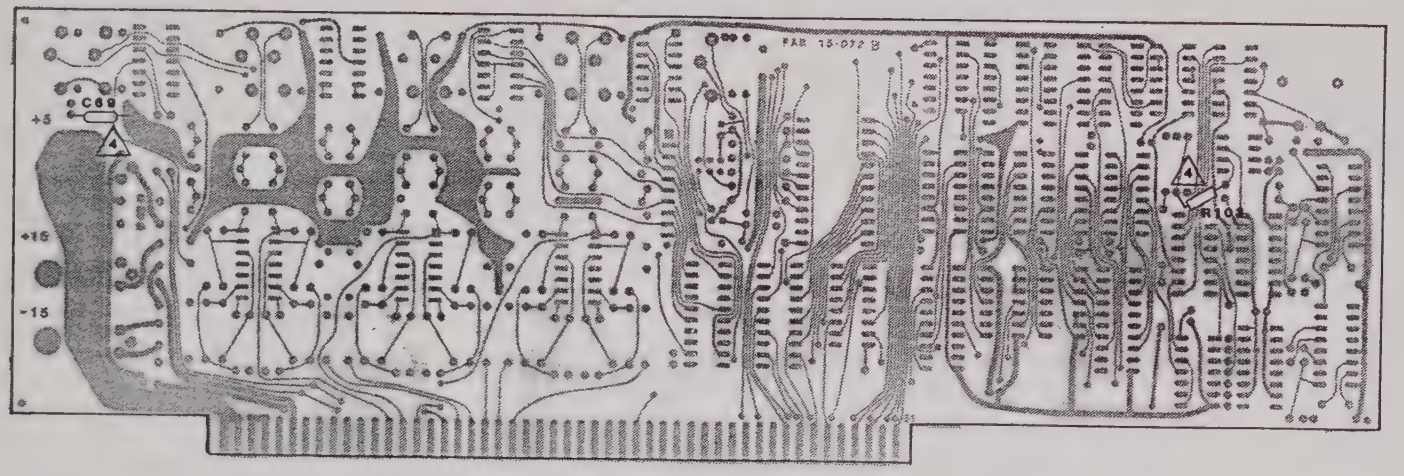
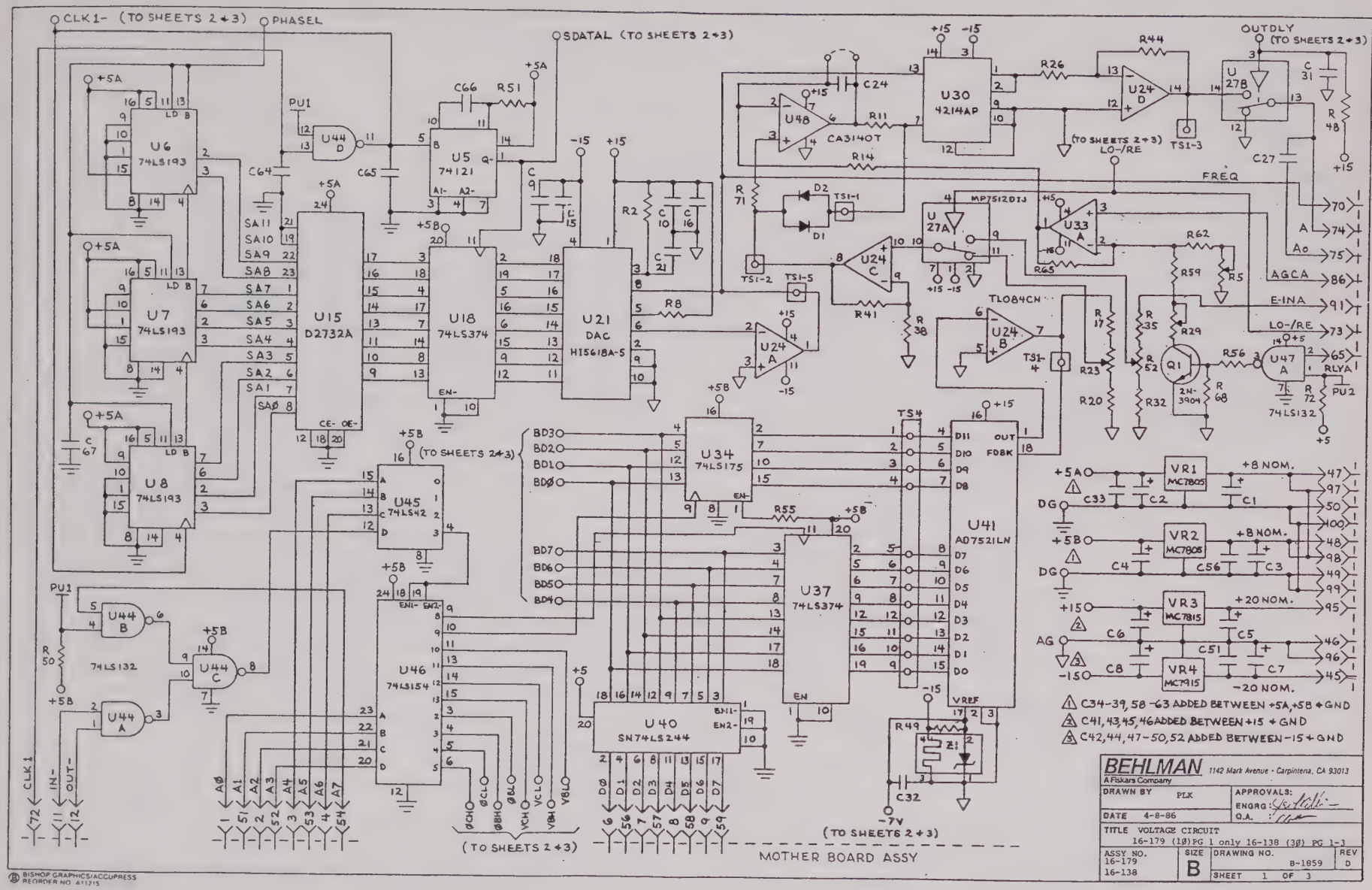


16-201	B-2197
16-190	B-2051
NEXT ASSY	REF. DWG
APPLICATION	

BEHLMAN 1142 Mark Avenue • Carpinteria, CA 93013
A Fiskars Company

DRAWN BY SEV		APPROVALS: ENGRG: Jay Killi	
DATE 6-29-88		Q.A. : Jean Sivard	
TITLE COMPONENT LAYOUT-PWA, MEAS. CARD, 10			
PART NO. 100-392-CMP (16-189)	SIZE B	DRAWING NO. 2050	REV E
		SHEET 2 OF 2	



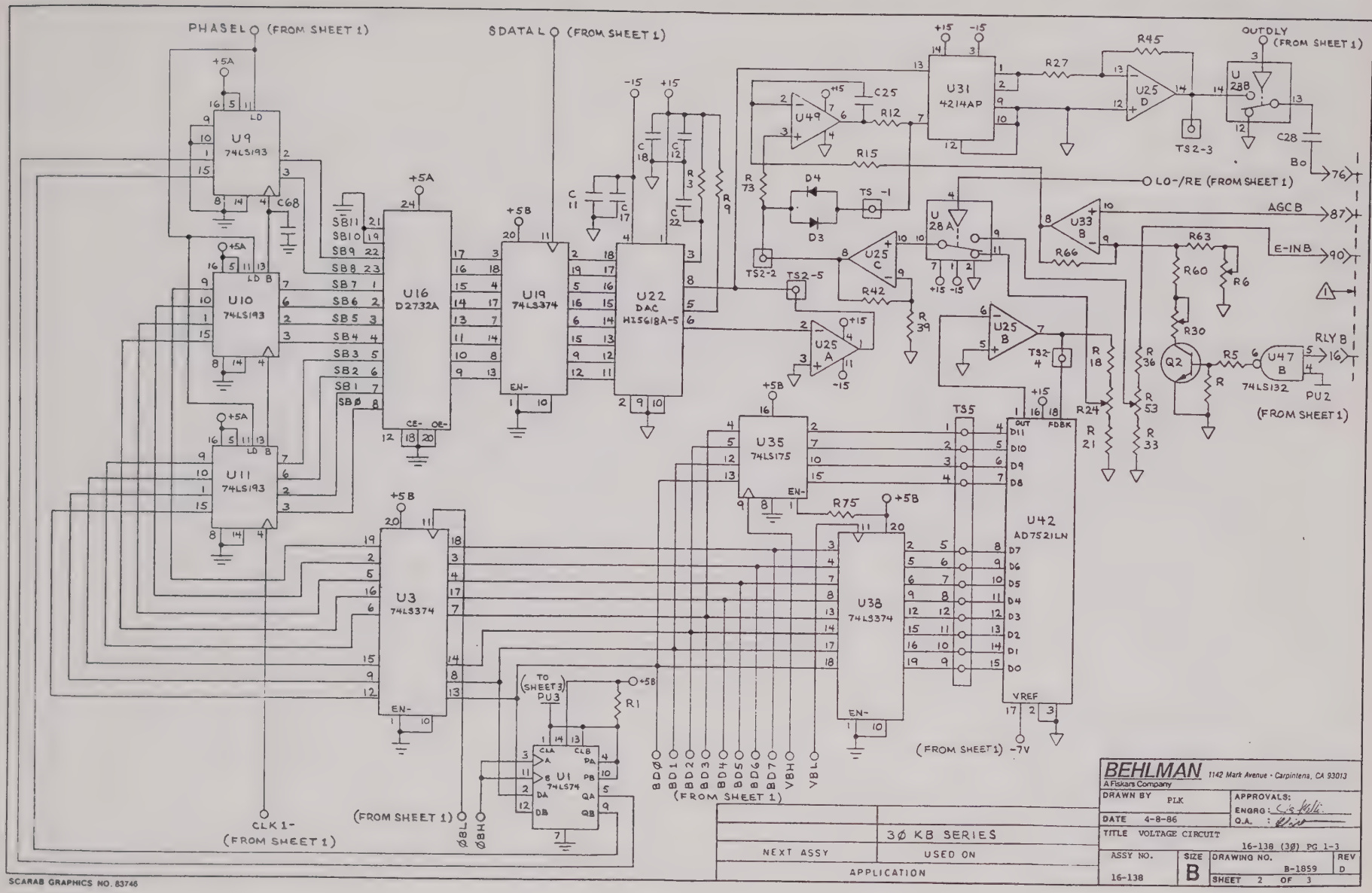
BEHLMAN 1142 Mark Avenue · Carpinteria, CA 93013
A Fiskars Company

DRAWN BY	PLK	APPROVALS:	
DATE	4-8-86	ENGRG	
		Q.A.	

TITLE VOLTAGE CIRCUIT
16-179 (1Ø) PG 1 only 16-138 (3Ø) PG 1-3

ASSY NO.	SIZE	DRAWING NO.	REV
16-179 16-138	B	B-1859	D
		SHEET 1 OF 3	

BISHOP GRAPHICS/ACCUPRESS
REORDER NO. A11215

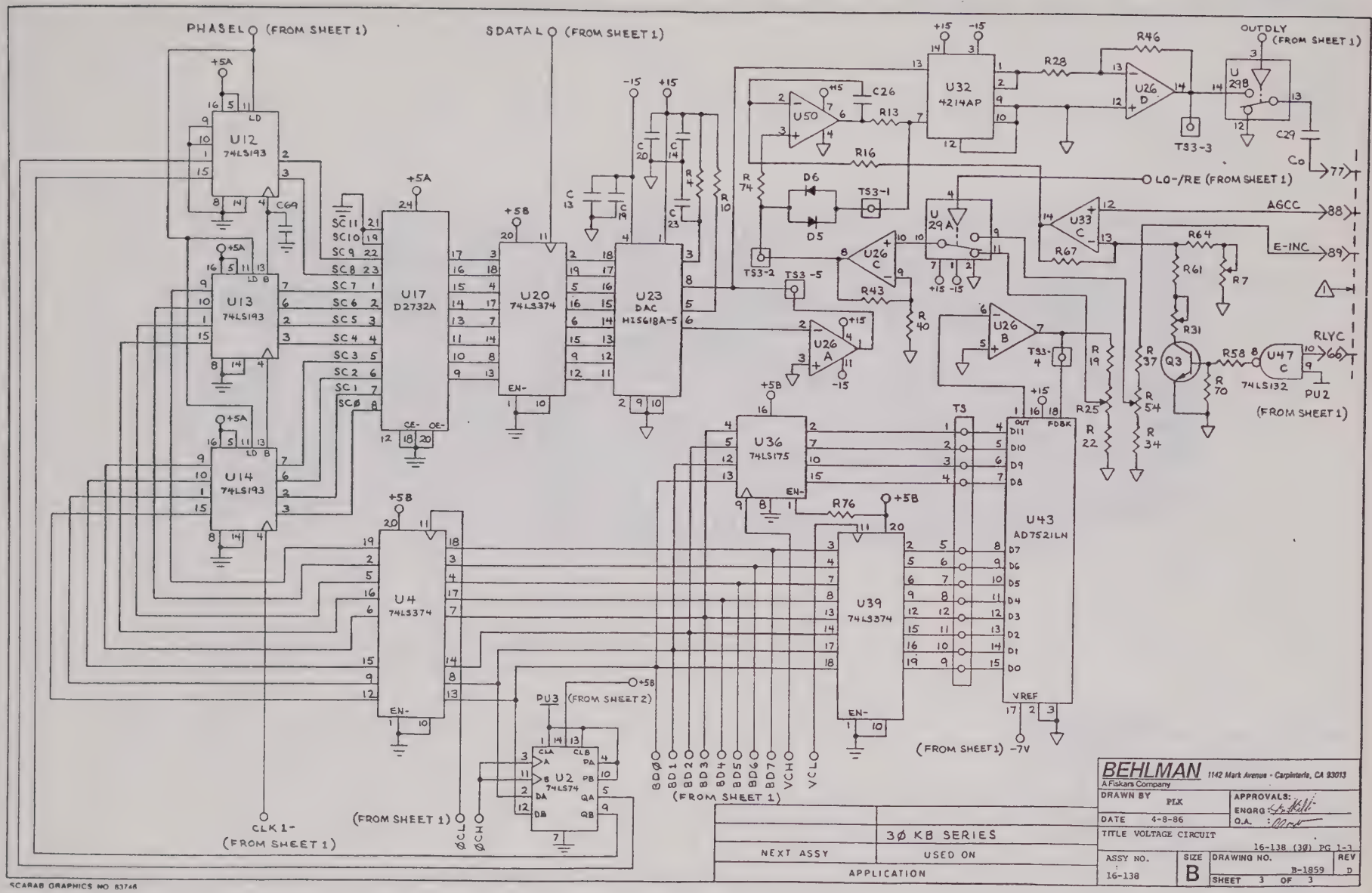


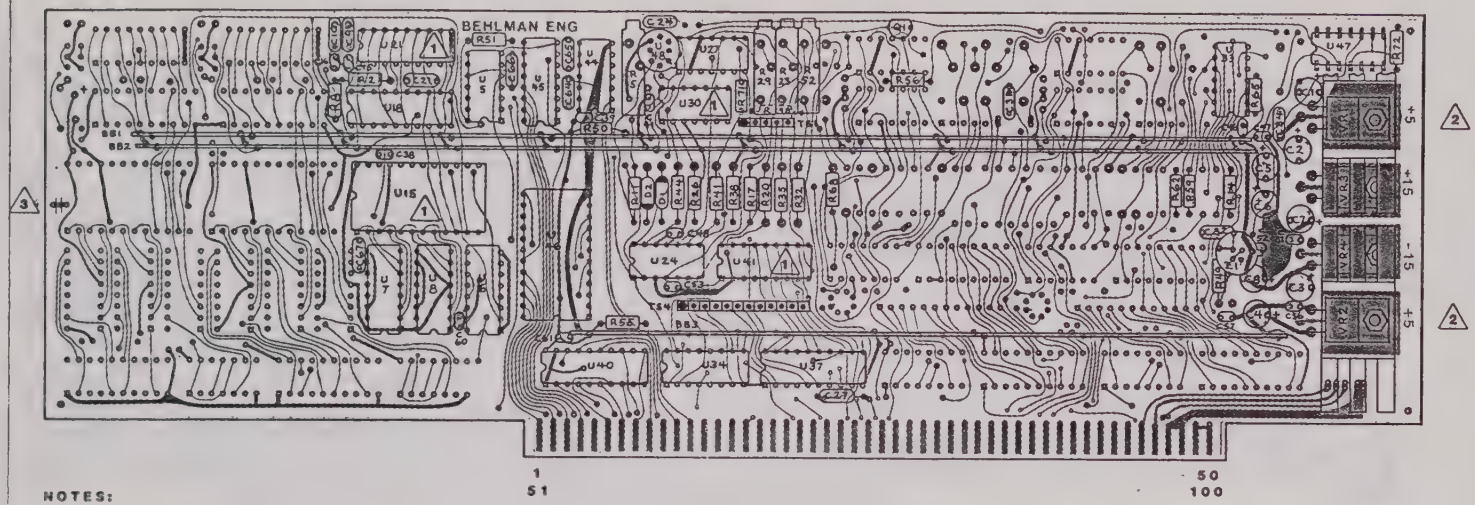
	3Ø KB SERIES
NEXT ASSY	USED ON
APPLICATION	

BEHLMAN 1142 Mark Avenue - Carpinteria, CA 93013
A Fiskars Company

DRAWN BY	PLK	APPROVALS:	
DATE	4-8-86	ENGRG:	
		Q.A. :	
TITLE	VOLTAGE CIRCUIT		
		16-138 (3Ø) PG 1-3	
ASSY NO.	16-138	SIZE B	DRAWING NO. B-1859 REV D
			SHEET 2 OF 3

SCARAB GRAPHICS NO. 83746


PHASEL (FROM SHEET 1)
SDATA L (FROM SHEET 1)
OUTDLY (FROM SHEET 1)
LO-/RE (FROM SHEET 1)
AGCC
E-INC
RLYC
(FROM SHEET 1)
U12 74LS193
U13 74LS193
U14 74LS193
U17 D2732A
U20 74LS374
U23 DAC HI5618A-5
U32 4214AP
U50
U26 A
U26 B
U26 C
U26 D
U29 A
U33 C
U36 74LS175
U4 74LS374
U39 74LS374
U43 AD7521LN
U2 74LS74
U47 C 74LS132
Q3
PU3 (FROM SHEET 2)
PU2
TS3-1
TS3-2
TS3-3
TS3-4
TS3-5
R28
R46
R13
R16
R43
R76
R64
R61
R7
R31
R58
R70
R54
R34
R25
R22
R19
R37
R40
C26
C29
Co
CLK 1- (FROM SHEET 1)
ØCL
ØCH
BD0 BD1 BD2 BD3 BD4 BD5 BD6 BD7 VCH VCL (FROM SHEET 1)
(FROM SHEET 1) -7V
BEHLMAN 1142 Mark Avenue - Carpinteria, CA 93013
A Fiskars Company
DRAWN BY PJK
DATE 4-8-86
APPROVALS: ENGRG O.A.
TITLE VOLTAGE CIRCUIT
16-138 (3Ø) PG 1-1
3Ø KB SERIES
NEXT ASSY
USED ON
APPLICATION
ASSY NO. 16-138
SIZE B
DRAWING NO. B-1859
REV D
SHEET 3 OF 3
SCARAB GRAPHICS NO 83746



NOTES:

1. SOCKETS REQUIRED.
2. INSTALL 60708 HEAT SINK WITH THERMALCOTE #251 THERMAL JOINT COMPOUND OR EQUIVALENT.
3. CUT TRACE
4. ADD JUMPER #26 AWG BUSSWIRE SHIELDED, SOLDER SIDE.

NEXT ASSY	USED ON
APPLICATION	

BEHLMAN A Fiskars Company — 1142 Mark Avenue • Carpinteria, CA 93013

DRAWN BY PLK	APPROVALS: ENGRG: Jas F Killian Q.A. : Joan Stygar
DATE 2-24-88	
TITLE: SINGLE, PHASE VOLTAGE CARD	
ASSY. NO. 16-179 102-382-CMP	SIZE B
DRAWING NO. B-2037	REV E
SHEET 1 OF 2	

SCARAB GRAPHICS NO 83746

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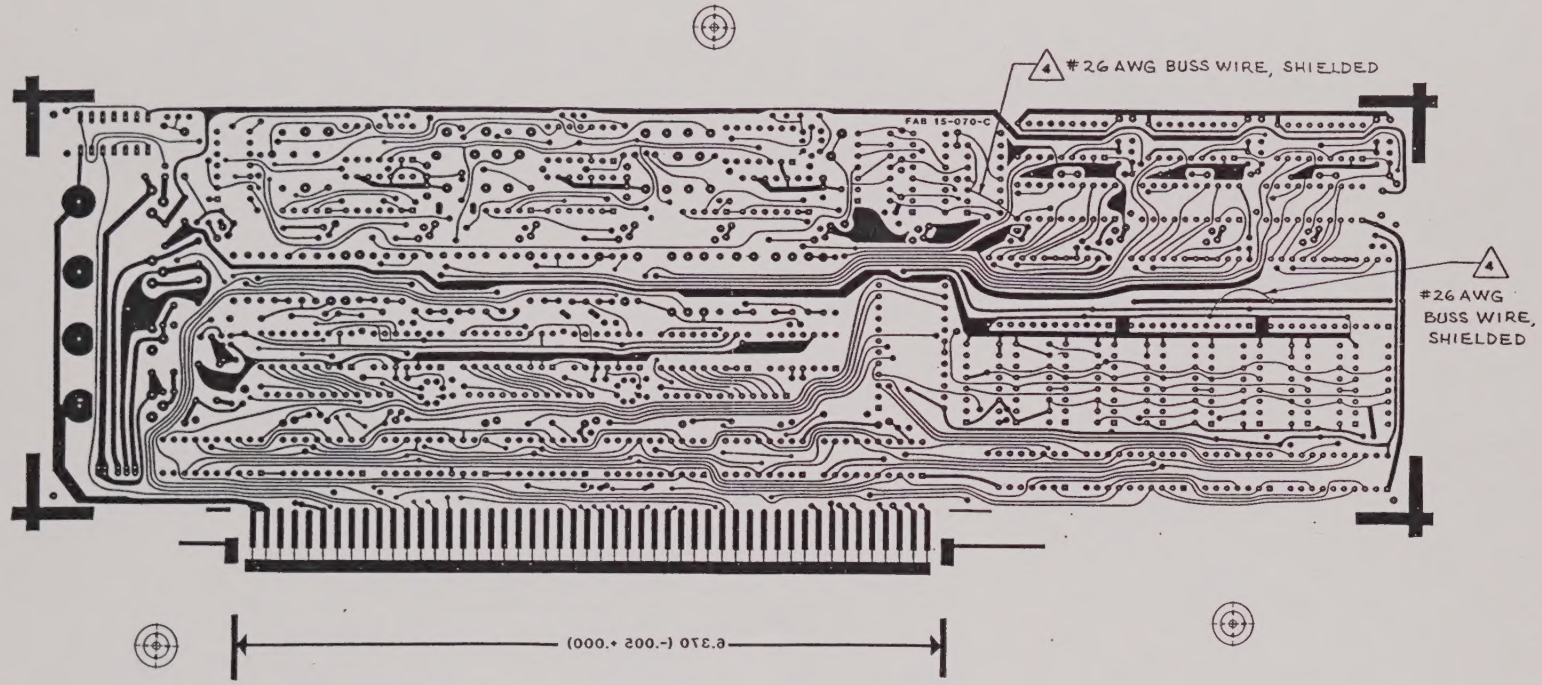

CIRCUIT SIDE

BEHLMAN 1142 Mark Avenue • Carpinteria, CA 93013
A Fiskars Company

DRAWN BY PLK		APPROVALS: ENGRG:	
DATE 2-24-88		Q.A. :	
TITLE SINGLE PHASE VOLTAGE CARD			
ASSY NO. 16-179 102-382-CMP	SIZE B	DRAWING NO. 2037	REV E
		SHEET 2 OF 2	

MP MASTER
MA29410

BEHLMAN
An Astrosystems Company